Aviation Week

Including Space Technology

May 4, 1959

TRANSPORT REPORTS:

- **Airline Outlook**
- **JT4 Turbojet**

TWA Boeing 707 Over Golden Gate Bridge

Air Transport Facts and Figures

Convair
. and the ages
we live in

JET AGE • MISSILE AGE
SPACE AGE • ATOMIC AGE

In this era that probes beyond all scientific horizons, the Convair division of General Dynamics Corporation has attained famous firsts in all four areas. **JET AGE:** B-58, first supersonic bomber. **MISSILE AGE:** Atlas, our first Intercontinental Ballistic Missile. **SPACE AGE:** The world's first ICBM to be placed in orbit. **ATOMIC AGE:** Convair was first to make tests on a nuclear reactor carried in flight.

Convair, as a member of the General Dynamics industrial family, is assisting to assure world peace and expanded scientific knowledge in the four ages we live in—an era unequalled in all of history!

CONVAIR
A DIVISION OF **GENERAL DYNAMICS CORPORATION**

DESTINATION KNOWN
When a mighty "Thor" blasts off from Vandenberg Air Force Base it is checked out, launched and tracked by Packard Bell's ground support equipment and Missile Impact Prediction System.
ENGINEERING BEYOND THE EXPECTED
The Missile Impact Predictor is one-eighth the size and was built at one-tenth the cost of previous systems. Ground support equipment matches the reliability built into the "Thor." All combine to guarantee an effective weapon for retaliation or space exploration... destination known.
PACKARD BELL ELECTRONICS
Technical Products Division

"OVER-THE-HUMP" SCATTER
ANTENNA BY KENNEDY

THESE CAMELS HAVE JUST WALKED A MILE to view the latest 60-foot steel and 28-foot aluminum antenna systems at a relay station in one of our overseas tropo scatter communications networks.

ANTENNA EQUIPMENT

D. S. KENNEDY & CO.

COHASSET, MASS. EVergreen 3-1200

Down-To-Earth **SOLUTIONS** *to Out-Of-This-World* **PROBLEMS**

Tracking Antennas
Radio Telescopes
Radar Antennas
"Trans-Horizon" Antennas
Tropospheric Scatter
Ionospheric Scatter

AVIATION CALENDAR

May 9—Federal Aviation Agency's "fly-in" for pilots and aircraft owners, National Aviation Facilities Experimental Center, Atlantic City, N. J.

May 15-16—Spring Meeting, Society of Aircraft Materials and Process Engineers—Eastern Division, Hotel Statler, New York, N. Y.

May 18—Symposium on Space Medicine Electronics, Franklin Institute, Philadelphia, Pa.

May 18-21—18th Annual National Conference, Society of Aeronautical Weight Engineers, Hotel Henry Grady, Atlanta, Ga.

May 19-21—Middle Eastern District Meeting, American Institute of Electrical Engineers, Lord Baltimore Hotel, Baltimore.

May 20-22—National Spring Meeting & Exhibition, Society for Experimental Stress Analysis, Sheraton Park Hotel, Washington, D. C.

May 20-22—Second Jet Age Airport Conference, American Society of Civil Engineers, Shamrock-Hilton Hotel, Houston, Tex.

May 21-22—1959 Ohio Valley Instrument and Automation Exhibit and Symposium, Cincinnati Section, Instrument Society of America, Music Hall, Cincinnati, Ohio.

May 24-June 5—Federation Aeronautique Internationale Annual Meeting, Moscow, USSR.

May 25-27—1959 National Telemetering Conference on Investigation of Space, Brown Palace and Cosmopolitan Hotel, Denver, Colo. Sponsors: American Rocket Society, Institute of the Aeronautical Sciences, American Institute of Electrical Engineers and Instrument Society of America.

May 25-27—All Industry Production and Quality Control Exposition and Convention, American Society for Quality Control, Cleveland Public Hall and Hotel Sheraton, Cleveland, Ohio.

(*Continued on page 6*)

AVIATION WEEK Including Space Technology

May 4, 1959
Vol. 70, No. 18

Published weekly with an additional issue in December by McGraw-Hill Publishing Company. James H. McGraw (1860-1948), Founder. See panel below for directions regarding subscription or change of address. **Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y.** Publication Offices, 99-129 North Broadway, Albany 1, N. Y. Donald C. McGraw, President; Joseph A. Gerardi, Executive Vice President; L. Keith Goodrich, Vice President and Treasurer; John J. Cooke, Secretary. Officers of the Publications Division: Nelson L. Bond, President; Harry L. Waddell, Senior Vice President; Ralph B. Smith, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venesian, Vice President and Circulation Coordinator.

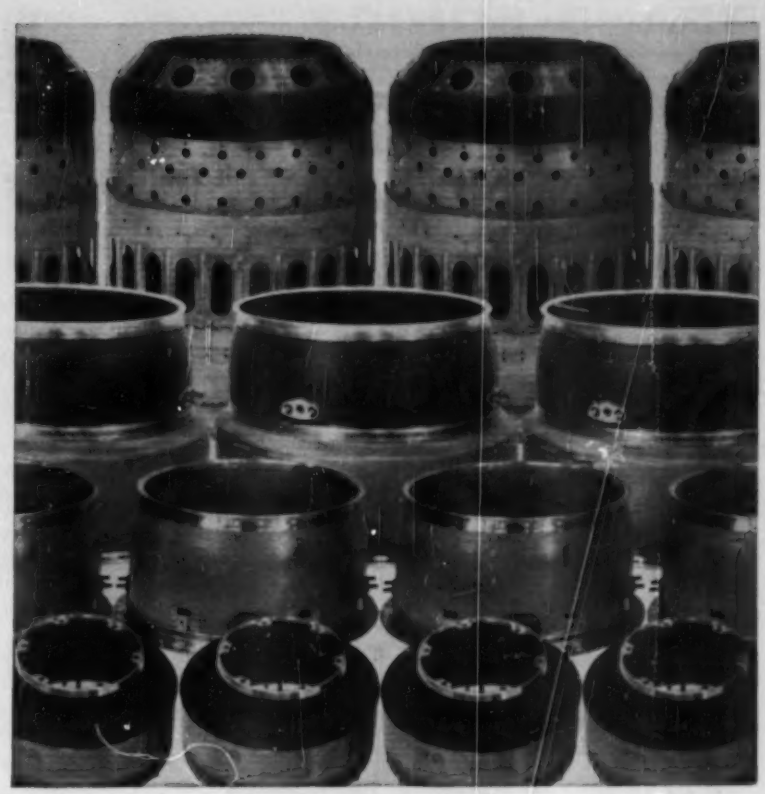
Subscriptions are solicited only from persons who have a commercial or professional interest in aviation, including missiles and space technology. Position and company connection must be indicated on subscription order.

Single copies 75¢. Subscription rates—United States and possessions, $7 one year. Canada $8 one year. All other countries, $30 one year.

Second class postage paid at Albany 1, N. Y. Printed in U. S. A. Title registered in U. S. Patent Office.
©Copyright 1959 by McGraw-Hill Publishing Co., Inc. All rights reserved. Cable Address: "McGraw-Hill New York." Publications combined with AVIATION WEEK including SPACE TECHNOLOGY are AVIATION, AVIATION NEWS, AIR TRANSPORT, AERONAUTICAL ENGINEERING and AIRCRAFT JOURNAL. All rights to these names are reserved by McGraw-Hill Publishing Co.

Subscribers: Send correspondence and change of address to Fulfillment Manager, Aviation Week, 330 West 42nd Street, New York 36, N. Y. Subscribers should notify Fulfillment Manager promptly of any change of address, giving old as well as new address, including postal zone number. Enclose recent address label if possible. Allow one month for change to become effective.

Postmaster: Please send form 3579 to Aviation Week, including Space Technology, 330 West 42nd Street, New York 36, N. Y.



precision

ENGINE COMPONENTS BY LAVELLE

Precision production of jet engine components is a job for specialists. Broader use of jet-propulsion in helicopters, missiles and drones puts new demands on the high performance small jet engine . . . and on the precision workmanship required in the manufacture of its parts. "Hot end" components must withstand high stresses and temperatures . . . require exacting fabrication, welding, machining and inspection . . . to close dimensional tolerances.

Lavelle specializes in producing precision sheet metal engine components. Combustion chambers, casings, exhaust nozzles and housings are typical parts produced in quantity for principal turbojet and turboprop engine manufacturers. They depend on Lavelle's experience and facilities for quality workmanship, dependable delivery . . . at reasonable cost.

An illustrated brochure details Lavelle's ability to produce the precision aircraft components you need . . . when you need them. Write for your copy today.

Lavelle

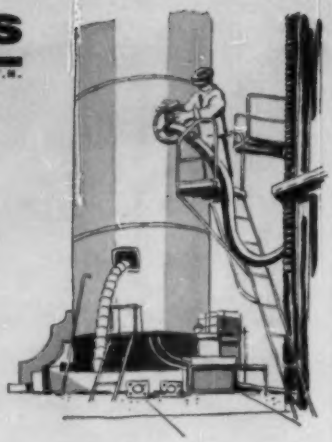
LAVELLE AIRCRAFT CORPORATION • NEWTOWN, BUCKS COUNTY, PA.
Between Philadelphia, Pa., and Trenton, N.J.

TRANS-SONICS

QUARTECTOR*

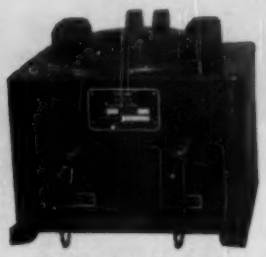
LIQUID LEVEL DETECTION SYSTEMS

for liquid oxygen and rocket fuels



- No moving parts assure unsurpassed reliability
- Will not respond to wetting or splashing

IN-TANK SENSOR



ELECTRONIC UNIT
Explosion-proof version for ground installation

IN-LINE PROBE

Quartector Liquid Level Detection Systems, with no moving parts to stick or freeze, detect liquid levels to within ± 1/32" with a response time of less than 40 milliseconds. Operating temperature range is from −425°F to +120°F.

Quartector systems and instruments are designed for *bulk liquid applications* such as fuel tanks in missiles or other types of pressure vessels, and for *pumping applications*. A real-time indication is provided when the liquid has reached pre-selected points in pipe lines or tanks.

The Quartector sensing element is a piezo-electric quartz crystal mounted in a probe or submersible sensor unit. Circuitry consists of a four stage transistor amplifier with a transistor detector circuit in the feedback loop, and an output control relay. When the crystal is in gas, it is free to vibrate at its natural frequency, and oscillation is sustained. When the crystal is submersed in liquid, however, its motion is damped, signal output drops, and the output control relay is de-energized.

Splashing, bubbles, and wetting do not affect the sensor. Liquid indication is given only when the crystal is completely surrounded by liquid. Safety features include a fail-safe and function test procedure. Write to Trans-Sonics, Inc., Dept. 7, Burlington, Massachusetts, for Technical Bulletin 1900.

TRANS-SONICS

Precision Transducers

*TRADEMARK

AVIATION CALENDAR

(Continued from page 5)

May 25-28—Design Engineering Show and Conference, American Society of Mechanical Engineers, Convention Hall, Philadelphia, Pa.

May 26-28—Supersonic Transport Meeting, San Diego Section, Institute of the Aeronautical Sciences, San Diego, Calif.

May 29-31—Soaring Society of America's Northeastern Soaring Meet, Dutchess County Airport, Poughkeepsie, N. Y.

June 1-3—Third Annual Summer Conference on Vacuum Metallurgy, New York University's College of Engineering, University Heights, Bronx, N. Y.

June 1-3—National Symposium, Institute of Radio Engineers' Professional Group on Microwave Theory & Techniques, Harvard University, Cambridge, Mass.

June 4-5—Third National Conference, Institute of Radio Engineers' Professional Group on Production Techniques, Villa Hotel, San Mateo, Calif.

June 5-6—Annual Meeting of the Army Aviation Assn. of America, Shoreham Hotel, Washington, D. C.

June 5-6—10th Annual Maintenance & Operations Meeting, Reading Aviation Service, Inc., Municipal Airport, Reading, Pa.

June 8-9—Industry Missile and Space Conference, Sheraton-Cadillac Hotel, Detroit, Mich. Sponsor: Aero Club of Michigan.

June 8-11—Semiannual Meeting and Astronautical Exhibition, American Rocket Society, El Cortez Hotel, San Diego, Calif.

June 12-21—23rd French International Air Show, Le Bourget, Paris, France.

June 14-18—Semiannual Meeting, American Society of Mechanical Engineers, Chase-Park Plaza Hotel, St. Louis, Mo.

June 16-19—National Summer Meeting, Institute of the Aeronautical Sciences, Ambassador Hotel, Los Angeles, Calif.

June 21-26—Summer-Pacific General Meeting and Air Transportation Conference, American Institute of Electrical Engineers, Olympia Hotel, Seattle, Wash.

June 23-25—33rd Meeting, Aviation Distributors and Manufacturers Assn., St. Francis Hotel, San Francisco, Calif.

June 29-July 1—Third National Convention on Military Electronics, Sheraton-Park Hotel, Washington, D. C. Sponsor: Institute of Radio Engineers' Professional Group on Military Electronics.

June 29-July 3—Summer seminar on Plastics—Its Mechanical Properties, Design and Applications, Pennsylvania State University, University Park, Pa.

July 1-10—U. S. National Soaring Competition, Harris Hill, Elmira, N. Y.

July 30-31—Sixth Annual Symposium on Computers and Data Processing, Denver Research Institute, Stanley Hotel, Estes Park, Colo.

Aug. 31-Sept. 5—10th Annual Congress, International Astronautical Federation, Church House, Westminster, London.

Sept. 7-13—1959 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

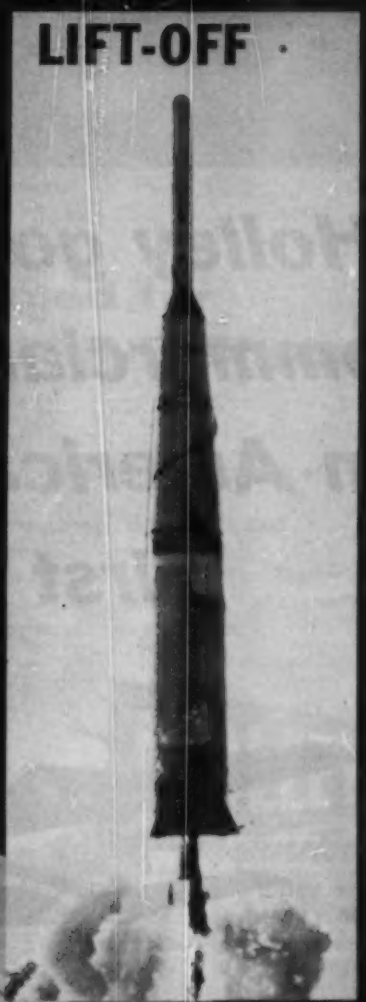
Oct. 12-16—15th General Convention of the International Air Transport Assn., Tokyo, Japan.

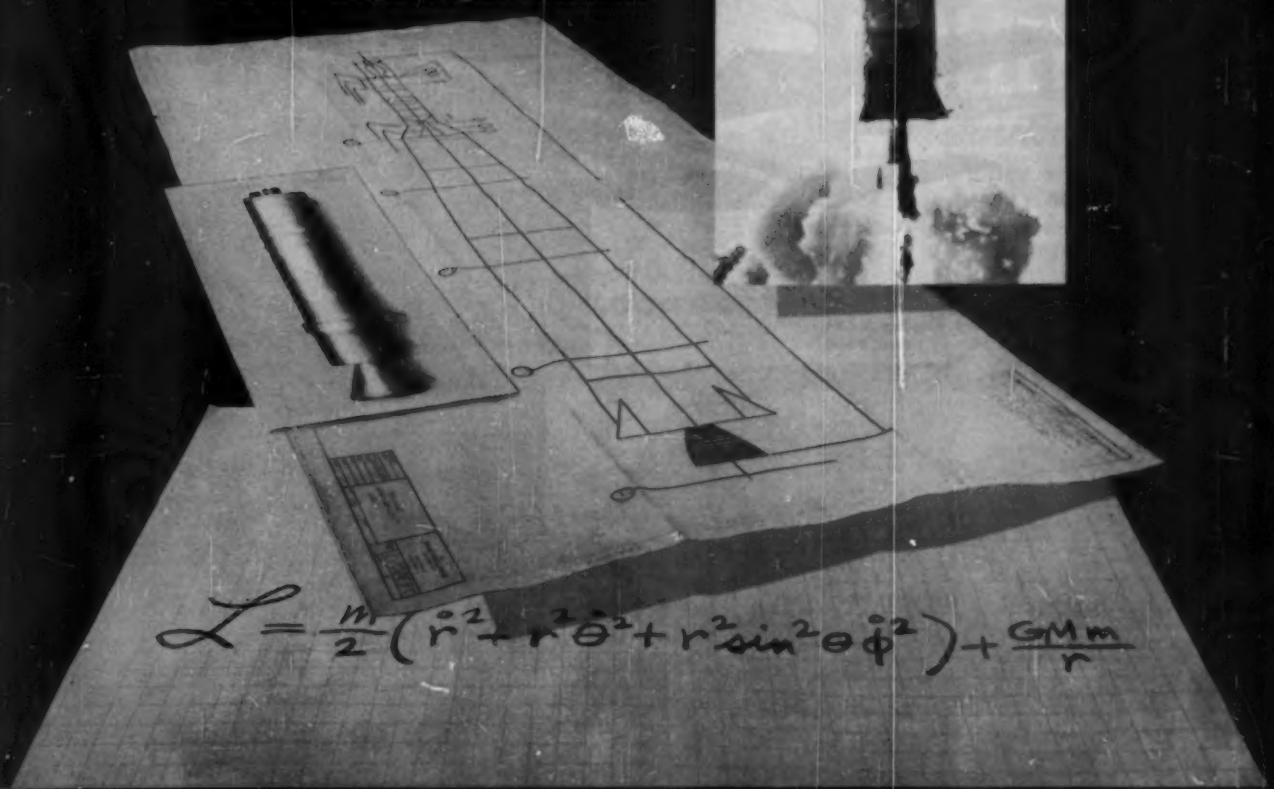
FROM LAGRANGIAN TO LIFT-OFF

Sometimes forgotten during the thundering ascent of a space probe rocket are months of meticulous analysis, engineering and planning. The staff of Space Technology Laboratories is now engaged in a broad program of space research for the Air Force, the National Aeronautics and Space Administration and the Advanced Research Projects Agency under the direction of the Air Force Ballistic Missile Division. For space probe projects STL provides the total concept approach, including preliminary analysis, sub-system development, design, fabrication, testing, launch operations and data evaluation. The total task requires subtle original analysis in many fields as well as sound technical management.

The STL technical staff brings to this space research the talents which have provided system engineering and technical direction since 1954 to the Air Force Ballistic Missile Program. Major missile systems currently in this program are Atlas, Titan, Thor and Minuteman.

The scope of STL's responsibilities offers creative engineers, physicists and mathematicians unusual opportunities to see their ideas tested in working hardware. Inquiries are invited regarding staff openings in the areas of Advanced Systems Analysis, Rocket Propulsion, Space Flight Mechanics, Dynamics, Structural Analysis, and Aerodynamics.





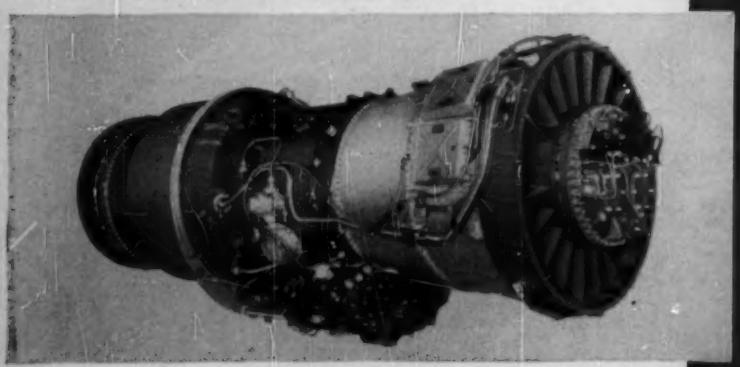
Space Technology Laboratories, Inc.
P. O. Box 95004, Los Angeles 45, California

The measures of ability

FUNCTION WEIGHT SIZE

Holley goes Commercial on America's First Jet Airliner

Power for America's first jet airliner is furnished by four of these compact, Pratt & Whitney Aircraft JT-3 Jet Engines which deliver more than 13,000 lbs. of thrust, each.



Record breaking Boeing 707 providing Americans with new speed and new comfort.

Holley Accessory selected for Pratt & Whitney Aircraft JT-3 Engine

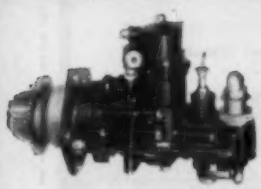
Three basic goals rule the efforts of design, engineering, and manufacturing engineers at Holley: exceed, if desirable, minimum performance standards, lessen the weight, and reduce the size to allow more freedom of location on the engine. Another proof of Holley's success in attaining these goals is the choice of a Holley engine accessory for the Boeing 707; the Holley designed, engineered, and manufactured compressor bleed governor. This product and other Holley jet engine accessories (like the ones shown below) demonstrate hour after hour, in the world's airways, the Holley skills developed over more than half-a-century.

HOLLEY Carburetor Co.

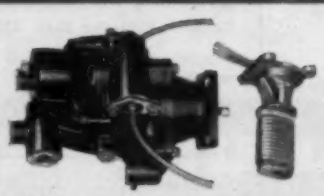
A-27 11955 E. NINE MILE ROAD
WARREN, MICHIGAN

Leader in the Design, Development and Manufacture of Aviation Fuel Metering Devices

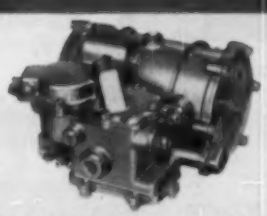
A few of Holley's Engine Accessories for Jet Aircraft



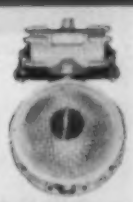
The Holley designed R-92 Compressor Bleed Governor for the Pratt & Whitney Aircraft JT-3 and J-57 Jet Engines.



A companion to the actuator is the R-98 Compressor Bleed Governor for the JT-4 Jet Engine.



Designed for Pratt & Whitney Aircraft JT-4 Jet Engine, the R-98 Bleed Piston Actuator is Holley designed and manufactured.



This bleed valve and actuator for the JT-3 Jet Engine is manufactured to Pratt & Whitney Aircraft design by Holley.

DONNER

lets you lead a Sikorsky with one hand!

Using only a few ounces of force, anybody can walk a helicopter fitted with automatic stabilization equipment using a Donner designed stabilizing coupler. In a more useful vein, the big birds perform vital tasks where the ability to hover precisely and maintain stability is critical. Currently, Donner equipped Sikorskys are used extensively for submarine detection, surveilance, rescue, lifting, and a host of other activities.

Transistorized Model 4310
0.1% linear accelerometer shown 1/2 size.

Heart of the Donner coupler is a small Donner servo accelerometer which measures linear acceleration to at least 0.1% of full scale. The internal servo system offers excellent resolution and linearity. These sturdy reliable instruments are hermetically sealed and magnetically shielded. The entire Donner system weighs less than 25 pounds.

Complete information is contained in Data File 410. Send for your copy without obligation — use the convenient coupon.

DONNER SCIENTIFIC COMPANY • CONCORD, CALIFORNIA

Send for data file 12

DONNER SCIENTIFIC COMPANY
Concord, California Dept. 055

Please send Data File 410 on your linear servo accelerometers.

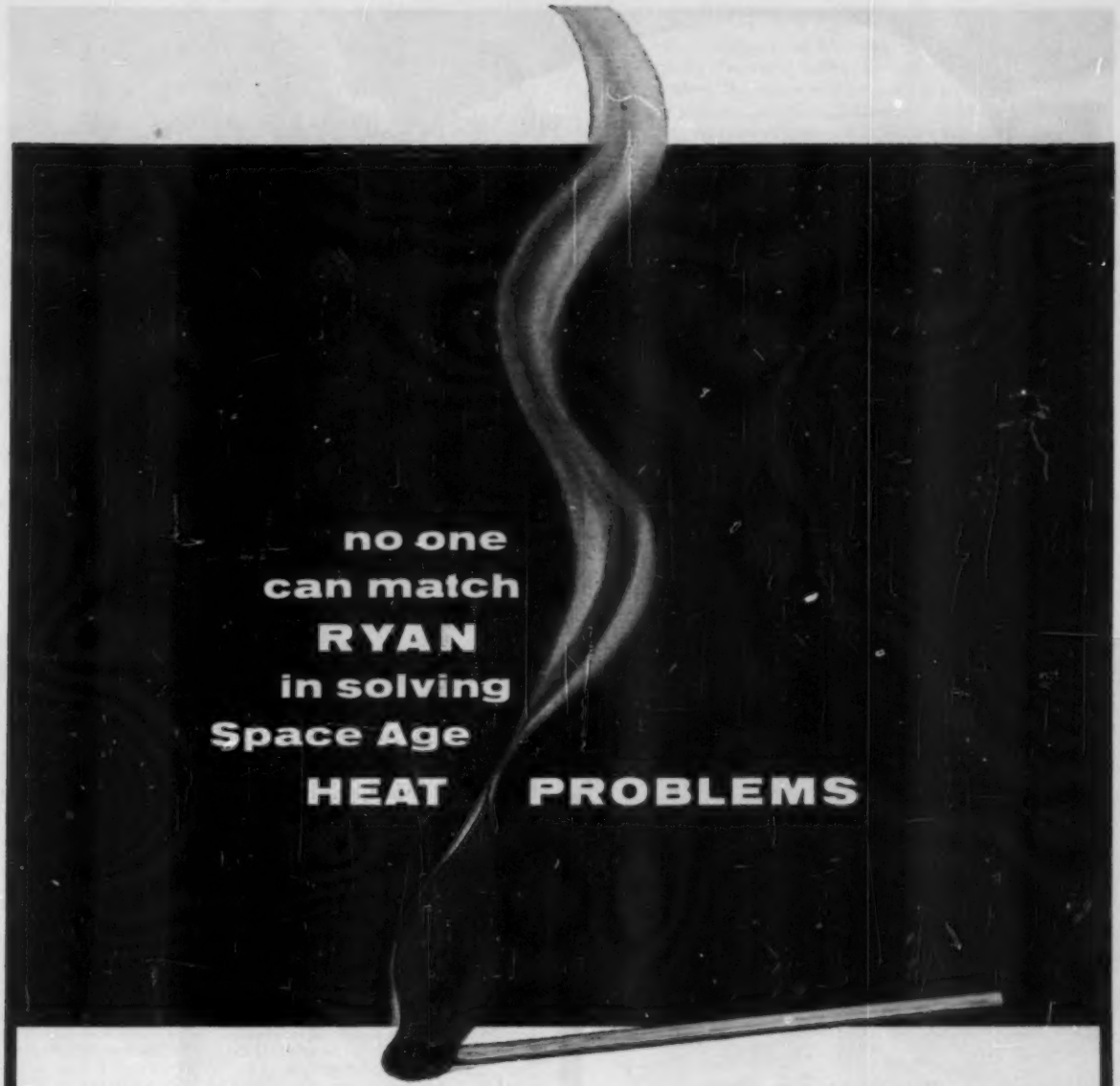
*Name*_____

*Title*_____

*Company*_____

*Street*_____

*City and State*_____



But if you want to try, do this:

- Spend 20 years applying advanced metallurgy to production.
- Shake down 35 high-temperature alloys in the laboratory.
- Fabricate these super-alloys into critical hot-part components for prototype power plants.
- Swing into volume production of proved designs.
- Prove, over and over again, that you know what you're doing—with jet, propjet and piston engine components and afterburners, ramjets and rocket motors.
- Make your name a byword for high-temperature research and development... for precision-made components and complete power packages.

Better still—take a 20-year stride by putting Ryan to work on your heat problems.

RYAN BUILDS BETTER

AIRCRAFT · POWER PLANTS · ELECTRONICS

Ryan Aeronautical Company, San Diego, Calif.

Koch Certified Global Survival Kits Set the Pace...

Koch Global Survival Kits, in full production since 1956, have already proved themselves to be miracles of life-saving precision.

Housed in a compact Fiberglas case beneath the pilot, the kit is ejected in emergencies with the pilot as he parachutes to safety. It contains an emergency 20-minute oxygen supply for high-altitude escape; self-inflating life raft; essential food, survival, signalling and rescue supplies.

Koch Survival Kits were first to meet specification MIL-27750B (USAF) and are also manufactured under MIL-S-26676 (USAF). Today they are standard equipment on USAF F-102, F-106, B-58 and F-105 aircraft, and the new experimental rocket powered aircraft X-15.

OVER 250,000 KOCH FIBERGLAS CASES PROTECT COSTLY EQUIPMENT...

Manufactured under MIL-C-4150E (USAF), Koch's air-tight, water-tight, shock-proof Fiberglas carrying cases save literally millions of dollars in equipment loss and damage.

Mildew-proof and fungus-proof, Koch cases will not dent, will withstand submersion indefinitely, and have a zero moisture and vapor transmission rate. They are permanent, re-usable. They are a Method II-D package and require no outer packaging for overseas shipment. They may be used for permanent storage.

NEW KOCH DIVISION FOR AERONAUTICAL HARDWARE

Koch's Oxygen-Electrical Quick Disconnect is one of a growing list of aircraft and missile accessories from Koch's high-precision Aero Hardware Division, and is now standard equipment on Convair B-58's and F-102's.

Koch is in current production on such other items as Missile Recovery System Timers, Ejection Seat Lap Belt Snaps and Fittings, and Parachute Automatic Pack Openers.

Koch experience, leadership and achievement are unparalleled in the nation. If you seek solutions to difficult problems in Fiberglas fabrication, materiel development, packaging, or in intricate hardware design, we will be glad to place our fifty years experience at your disposal.

KOCH *Fiberglas*

PRONOUNCED "KOKE"

50TH Anniversary

H. KOCH & SONS

BOX 102-A

CORTE MADERA, CALIFORNIA

Pioneers in Fiberglas Fabrication

Originator of Koch Fiberglas Luxury Luggage—engineered for the man who travels a lot.

GPL research

Nuclear Gyros

GPL research is now studying for the U. S. Air Force the feasibility of harnessing the most efficient gyro known to science—the nucleus of the atom. Development of such a gyro—tremendously accurate, perfectly balanced, friction and maintenance free—will revolutionize space reference, navigation and guidance techniques.

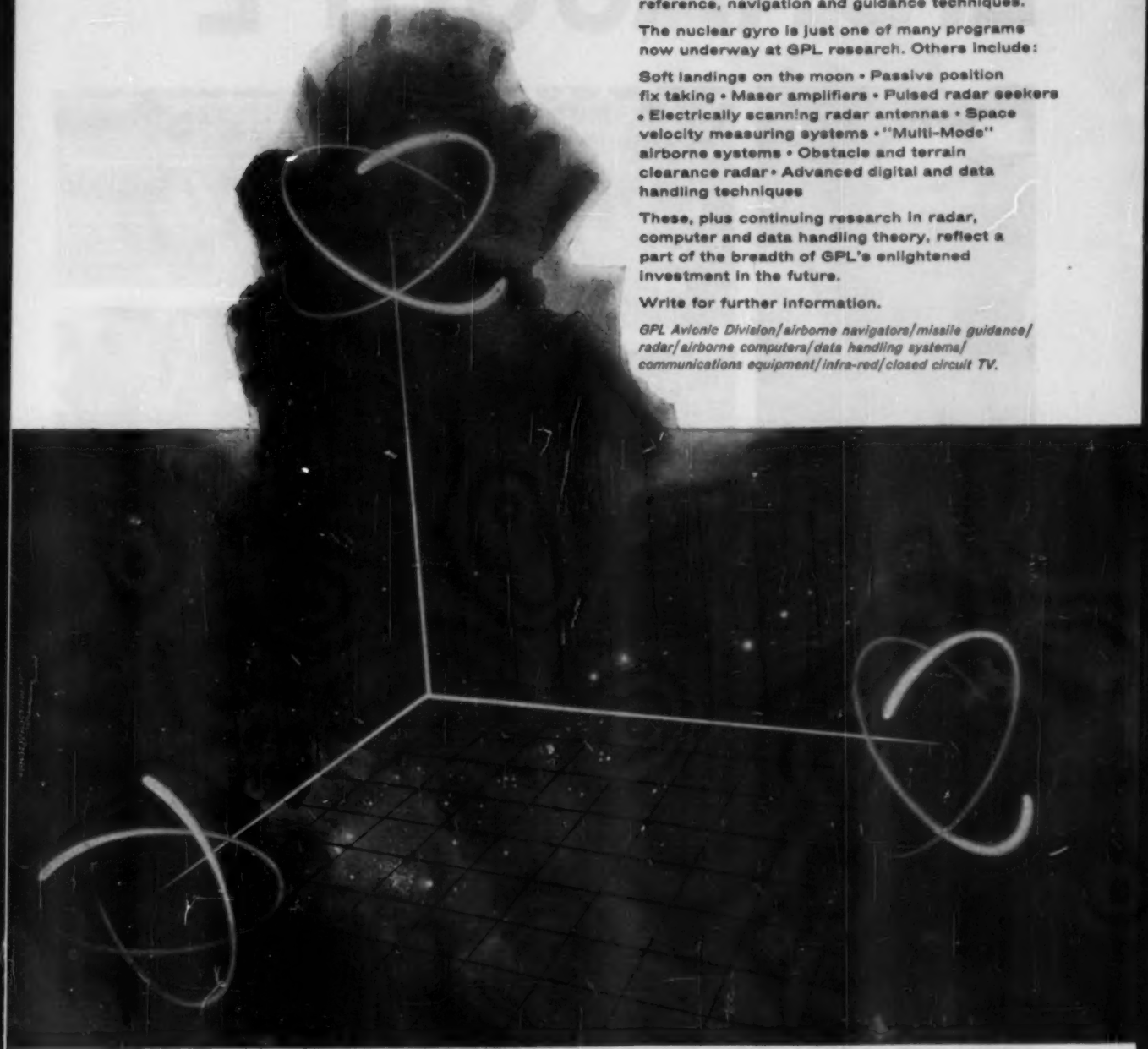
The nuclear gyro is just one of many programs now underway at GPL research. Others include:

Soft landings on the moon • Passive position fix taking • Maser amplifiers • Pulsed radar seekers • Electrically scanning radar antennas • Space velocity measuring systems • "Multi-Mode" airborne systems • Obstacle and terrain clearance radar • Advanced digital and data handling techniques

These, plus continuing research in radar, computer and data handling theory, reflect a part of the breadth of GPL's enlightened investment in the future.

Write for further information.

GPL Avionic Division/airborne navigators/missile guidance/radar/airborne computers/data handling systems/communications equipment/infra-red/closed circuit TV.



ENGINEERS — GPL achievements have opened up some unusual research and development opportunities. Send resume to Personnel Director.

MANUFACTURING

ENVIRONMENTAL TESTING

CUSTOMER SERVICE

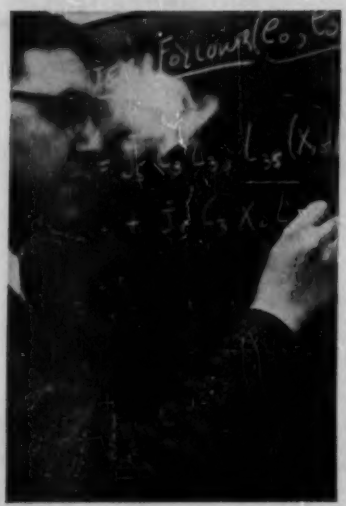
RESEARCH / ENGINEERING / FLIGHT TESTING

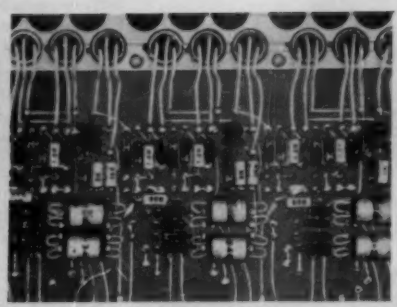
GPL | A GENERAL PRECISION COMPANY

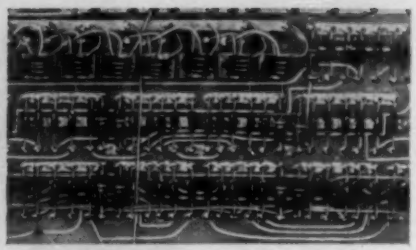
GENERAL PRECISION LABORATORY INCORPORATED, Pleasantville, N. Y.

A Subsidiary of General Precision Equipment Corporation

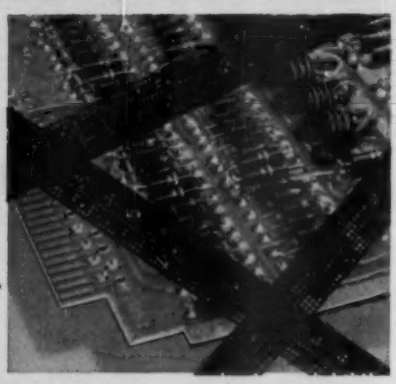
LIBRASCOPE







what goes into a computer system.....



...more than experienced engineering, more than parts, plans and programs. At Librascope, it is the ability to integrate components and brain-power into workable computer systems for the accurate translation of data.

Librascope engineers attain optimum system accuracy by weighing problems in terms of inputs available and outputs required to provide reliable answers.

This process, from concept to reality, has unlimited room for expression at Librascope where facilities including field test and simulation laboratories cover hundreds of thousands of square feet... where research—development of electronic, electro-mechanical, magnetic and optical computing techniques is a continuing, progressive program.

What goes into a Librascope computer system represents the best experience of two decades. For full details on how Librascope can anticipate and solve your computer and control problems, write...

For information on career opportunities at Librascope, write Glen Seltzer, Employment Manager.

LIBRASCOPE

A GENERAL PRECISION COMPANY

LIBRASCOPE, INC. • 808 WESTERN AVENUE • GLENDALE, CALIF. • *A Subsidiary of General Precision Equipment Corporation*

BURNDY *is proud to announce*

the acquisition of another leader

in connections for electrical and

electronic equipment...

H. H. Buggie, inc.

Broadening our services to the manufacturers of precision electronic products, we have acquired this established producer of high quality connectors, including miniature disconnects, printed circuit connectors, rack and panel connectors, co-axial and tri-axial connectors and radar pulse cable assemblies. One of the greatest values in this acquisition, we believe, is the addition to our organization of the outstanding engineering and manufacturing capabilities of H. H. Buggie, Inc.

OMATON DIVISION

BURNDY

NORWALK, CONNECT.

9148

ESSO JET AGE EXPERIENCE IS READY TO SERVE YOU NOW

ESSO PERFECTS JET AGE REFUELING FOR FAST, SAFE, DEPENDABLE SERVICE

Fast turn-around is essential to profitable airline operations. With the increased fuel capacities of the great new jet airliners, faster refueling becomes more important than ever before. Anticipating these jet age demands, Esso engineers have perfected *two* basic methods for refueling large airliners safely—and on schedule.

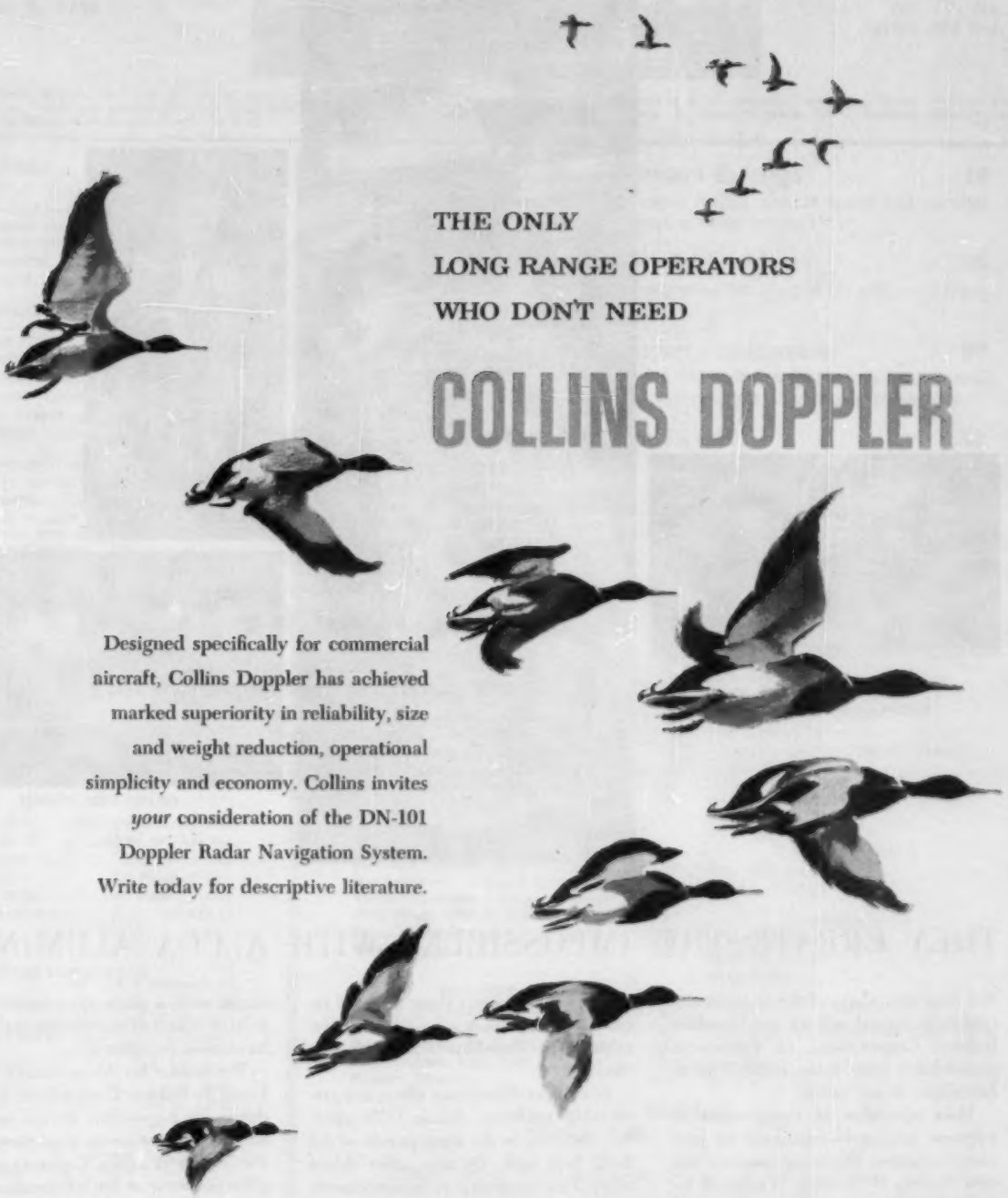
HYDRANTS—The Esso-developed hydrant refueling system was first installed 11 years ago. This practical and efficient method has since proved ideal for busy airports. New high-speed hydrant refueling systems are now being installed to serve the large jet airliners.

NEW REFUELING TRUCKS—New Esso refuelers feature greater capacity, higher pumping rates, improved filtration and greater mobility—to meet the increased demands of jet age airliners.

These modern refueling systems are two more examples of Esso leadership in petroleum service for today and tomorrow.

ESSO

AVIATION PRODUCTS



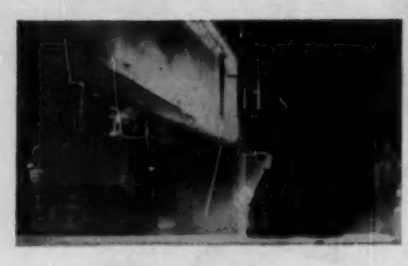
THE ONLY
LONG RANGE OPERATORS
WHO DON'T NEED

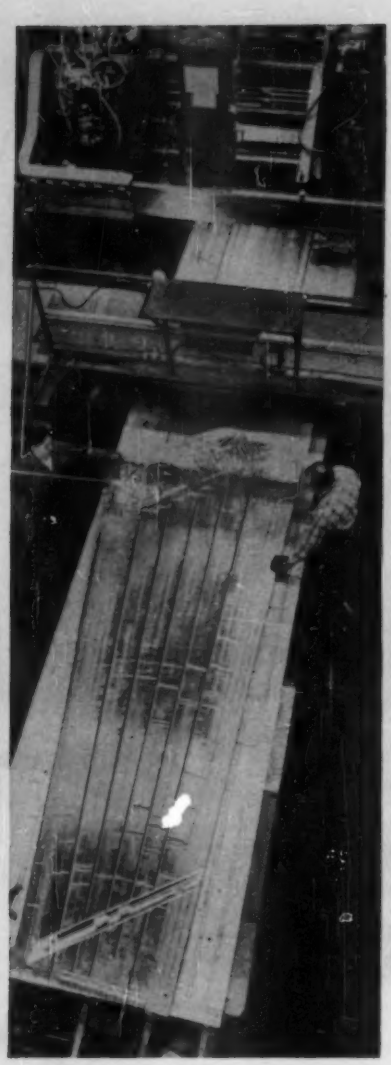
COLLINS DOPPLER

Designed specifically for commercial aircraft, Collins Doppler has achieved marked superiority in reliability, size and weight reduction, operational simplicity and economy. Collins invites *your* consideration of the DN-101 Doppler Radar Navigation System. Write today for descriptive literature.

COLLINS

COLLINS RADIO COMPANY • CEDAR RAPIDS, IOWA • DALLAS, TEXAS • BURBANK, CALIFORNIA





THEY CREATE THE IMPOSSIBLE—WITH ALCOA ALUMINUM

Not long ago, many of the components routinely turned out by the Franklin Balmar Corporation, of Baltimore, *would* have been quite impossible to fabricate—at *any* price.

They specialize in components of extreme intricacy—machined to precise tolerances. The components of the new Boeing B-52 wing, machined by Balmar as subcontractor for Fairchild Aircraft, are typical of the highly demanding work turned out by these precision "sculptors in aluminum."

Severe sculpturing can be performed satisfactorily only on aluminum of the highest quality. For this reason, Franklin Balmar must have top quality and dependable uniformity in the aluminum it uses. Alcoa has been able in all cases to satisfy these unusual requirements. This is why Alcoa® Aluminum is Franklin Balmar's first choice.

For Alcoa Aluminum alloys are predictably uniform. Alcoa 7178 alloy, for instance, in the wing panels of the B-52 fuel tank. Or any *other* Alcoa alloy. You can trust it to behave exactly the same, time after time. Once you've developed a production routine, you know it will produce identically reliable results continuously.

Another reason for Balmar's preference for Alcoa Aluminum is its high internal quality—an important consideration in work where the cost of machining may be many times the cost of the raw metal itself. A hidden flaw might ruin a piece *after* hundreds of dollars' worth of machining operations have been completed!

Preference for Alcoa Aluminum by Franklin Balmar Corporation is something—we hope—that should justify a similar preference on *your* part, when the need next arises. Contact our sales offices or write us for information: Aluminum Company of America, 2026-E Alcoa Building, Pittsburgh 19, Pa.

For Exciting Drama Watch "Alcoa Theatre," Alternate Mondays, NBC-TV, and "Alcoa Presents," Every Tuesday, ABC-TV

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

Your Guide to the Best in Aluminum Value

May 4, 1959

Aviation Week

Including Space Technology

Vol. 70, No. 18
Member ABP and ABC

EDITORIAL OFFICES: New York 36—330 W. 42nd St., Phone: LOngacre 4-3000 (Nights LO 4-3035) Washington 4, D. C.—National Press Bldg., Phones: NAtional 8-3414, REpublic 7-6630 Los Angeles 17—1125 West Sixth St., Phone: HUntley 2-5450 Dallas 1—1712 Commerce St. Phone: Riverside 7-5117 European Office—1 rue du Temple, Geneva, Switzerland, Phone: 32-35-63

PUBLISHER .....Robert W. Martin, Jr.
EDITOR.....Robert B. Hotz

MANAGING EDITOR.....William Gregory
EUROPEAN EDITOR.....David A. Anderton
WASHINGTON.....Cecil Brownlow
NEW YORK..Robert I. Stanfield, Harry Raven, Herbert J. Coleman
LOS ANGELES..Irving Stone, Richard Sweeney, Russell Hawkes, William S. Reed
DALLAS.....Craig Lewis
ENGINEERING..J. S. Butz, Jr., Michael Yaffee
AVIONICS...Philip J. Klass, James A. Fusca
CONGRESS..Katherine Johnsen, Ford Eastman
SPACE TECHNOLOGY.....Evert Clark
TRANSPORT.....Glenn Garrison, L. L. Doty, Robert H. Cook
EQUIPMENT.....Barry Tully
BUSINESS FLYING.....Erwin J. Bulban
ART EDITOR.....Lawrence J. Herb
SPECIAL PROJECTS .....John A. Nammack
EDITORIAL PRODUCTION....Arnold Sherman
ASSISTANT EDITORS....Elizabeth M. Hein, Edith Walford
EDITORIAL ASSISTANTS.....Marjorie Nail, Jerome Bailey, Marjorie Todd
LIBRARIAN .....Eleanor Milano

FOREIGN NEWS SERVICE

EDITOR.....John Wilhelm
LONDON.....John Tunstall
PARIS.....Robert E. Farrell
BONN.....Morrie Helitzer
MEXICO CITY.....Peter Weaver
TOKYO.....Sol Sanders

DOMESTIC NEWS BUREAUS

ATLANTA 3.....1301 Rhodes-Haverty Bldg.
CHICAGO 11.....520 No. Michigan Ave.
CLEVELAND 15.....1510 Hanna Bldg.
DETROIT 26.....856 Penobscot Bldg.
HOUSTON 25.....1303 Prudential Bldg.
SAN FRANCISCO 4.....68 Post St.

SALES

ADVERTISING SALES MANAGER E. P. Blanchard, Jr.
ATLANTA.....R. H. Powell
BOSTON.....A. C. Boughton
CHICAGO and ST. LOUIS.....J. S. Costello, D. C. Jackman
CLEVELAND.....H. P. Johnson
DALLAS.....R. T. Wood
DENVER.....John G. Patten
DETROIT.....R. R. Butera
LOS ANGELES.....C. F. McReynolds, D. T. Brennan, C. A. Ransdell
NEW YORK.....M. J. Storz, J. M. Grinton, J. D. Warth
PHILADELPHIA..J. D. Willis, W. L. Blanchard
SAN FRANCISCO.....William Woolston
PROMOTION & RESEARCH MGR..C. C. Gersna
RESEARCH AND MARKETING Mary Whitney Fenton, Jacqueline Gonnet

BUSINESS

BUSINESS MANAGER.....J. G. Johnson
CIRCULATION MANAGER.....T. J. Lucey
ASST. BUSINESS MANAGER ..W. V. Cockren
PRODUCTION MANAGER.....F. A. Dube

U. S. Airlines May Hit Record Earnings 26
► New economic study indicates airline growth trend will parallel an upward swing in U. S. gross national product.

U. S. Airlines Accumulate Jet Experience 38
► Turbojet transports require precise handling in air and on ground; jet ingestion is no great problem.

JT4 Will Grow as Transport Size Increases 60
► Pratt & Whitney has planned 50% growth factor into basic turbojet design to meet expected enlargement of subsonic transports.

Air Transport Facts and Figures 93

SPACE TECHNOLOGY
Nuclear Rockets May Fly by 1970... 83
Camera Photographs Sputnik Track... 89
NASA Plans Orbiting Laboratories... 92
Schriever Asks ARPA Abolishment... 28
Radiation's Effect on Monkey..... 29
X-15 Cockpit Mockup 29
Soviets Plan Surveillance Satellite... 33

MISSILE ENGINEERING
Hound Dog Operational Testing..... 33

AERONAUTICAL ENGINEERING
JT4 Designed for Growth 60
Sikorsky Envisions Supersonic Airliner 67
Swedish Cold Weather Operations... 70
Tu-114, Bear Bomber Compared..... 80
JT12 Installed on Flying Testbed.... 201
Production Briefing 76

AVIONICS
FAA Will Operate Civil Beacon..... 126
Westinghouse Infrared Systems..... 133
Three-Dimensional Cockpit Display .. 141
Field Effect Tetrode Developed 147
Expansions, Changes 149
Filter Center 151

BUSINESS FLYING
Cessna Acts to Capture Export Market 157
Radial Engines Power Widgeon..... 160
Beech Designs Modernization Kits... 163
First Trecker 166 Sold..... 167
Private Lines 170

AIR TRANSPORT
Air Transport Facts and Figures.... 93
Airlines May Hit Record Earnings.... 26
U. S. Airlines Acquire Jet Experience.. 38
Transatlantic Seating to Drop..... 40
F-27 Phase-In Costs Less Than Expected 45
TWA Organization Change 45
Electra Vibration Fix Proposed..... 47
Earlier Pilot Retirement Urged..... 47
Airline Traffic—February 49
British Supersonic Transport..... 55
Shortlines 52
Airline Observer 52

MANAGEMENT
AIA Attacks Renegotiation Policy.... 31
Single System Manager Bill Fought... 32
Who's Where 23
Industry Observer 23
Washington Roundup 25
News Digest 37

EQUIPMENT
New Aviation Products 173
What's New 175

FINANCIAL
Army Contracts 77
USAF Contracts 79
Navy Contracts 171

SAFETY
Pilot Error Blamed in Nantucket Crash 183

Calendar 5
Letters 214

EDITORIAL
Fill Those Seats..... 21

COVER: Trans World Airlines Boeing 707-120, flying over the Golden Gate bridge at San Francisco, Calif., symbolizes the beginning of transcontinental jet transportation. N731TW, TWA's first production 707, was delivered Jan. 29 and now is being used for pilot and maintenance training.

PICTURE CREDITS

Cover—TWA; 27, 76—Lockheed; 29—Howard Levy; 30, 92—NASA; 33—USAF; 47—Vickers-Armstrongs, Ltd.; 57—Continental Airlines; 60, 61, 66, 201—Pratt & Whitney; 67—Sikorsky; 70, 71 (bottom right), 73 (left)—Royal Swedish Air Force; 71, 73 (right)—D. A. Anderton; 126—FAA; 127—Airborne Instrument Lab.; 133, 135, 137—Westinghouse; 141, 143—Waldorf Instrument; 157—Cessna; 160—Pacific Aircraft Engineering Corp.; 163—Beech; 167—Trecker Aircraft Corp.; 171—Haloid Xerox.

77,410 copies of this issue printed

Zippered nose cone cover foils moisture, dust, abrasion

To protect the polished finish of missile nose cones from assembly to countdown, B. F. Goodrich fabricated unique zippered "all-weather" Nose Cone Covers for Avco's Research and Advanced Development Division.

Made from neoprene coated nylon fabric, this shipping cover has non-rigid neoprene ribs and spacers that keep it from riding down on the cone. Special B. F. Goodrich Pressure Sealing Zippers provide easy access and removal—yet seal positively against dust, dirt, grime, damaging impact.

B. F. Goodrich was asked to engineer this special project because of its widely-known ability to manufacture coated fabrics to any shape or size—as in aircraft baggage panels. In addition, the space-saving B. F. Goodrich Zipper—used widely for air ducts, inspection ports, access doors, and aileron gap seals—withstands any pressure up to the maximum strength of the zipper itself. And it, too, can be fitted to complex contours.

Tricky sealing problems like this one are just part of the day's work at B. F. Goodrich. Next time you have such a problem and need an answer—fast—write or call *B.F.Goodrich Aviation Products, a division of The B.F.Goodrich Company, Dept. AW-59, Akron, Ohio.*

B.F.Goodrich ***aviation products***

Fill Those Seats

Some 20 billion new seat miles must be filled on the planes of the U.S. domestic airlines fleet during the next three years if the promise of the jet transport age now dawning is to be truly fulfilled. Last year the domestic airline fleet offered an annual capacity of 40.6 billion seat miles. But by 1962 when the initial phase of the jet transport equipment program will have been completed this annual capacity will jump to over 60 billion seat miles, according to the best estimates available now and based on current equipment programs. From 1962 onward the airline industry will have to sell a high percentage of these 60 billion seat miles every year.

This will pose a truly formidable challenge to the airline industry in sales, passenger service and operational techniques. Much of the initial experience with new jet transports now in service on an extremely limited basis is detailed by AVIATION WEEK's transport staff in this current issue which also contains the 20th edition of Air Transport Facts and Figures, compiled by the Air Transport Assn. But the magnitude of the problem facing the airlines with fleet-wide operations of jet transports can better be gaged by looking back at the progress achieved during the first post-war decade. In the 10-year period from 1946 to 1955, domestic airline seat capacity increased about 22.5 billion seat miles—from a total of 7.5 billion in 1946 to 30 billion in 1955. Now in the next three years the airline industry must manage an increase of almost the same magnitude as it achieved during the first 10 postwar years.

Nobody but a confirmed optimist could survive in the aviation business. Therefore we cheerfully go on record with the prediction that the airlines will handle the absorption of this additional 20 billion seat miles annually in a profitable manner by the end of 1962 and, indeed, this capacity may well turn out to be inadequate to meet the passenger demand of the mid-1960s.

But this goal will not be achieved by the well-worn traditional grooves that have brought the air transport industry through the piston-engined era to the threshold of jet operation. It will require fresh and imaginative thinking on all the problems from fares to traffic control; bold, fast-moving management; and a far more responsive attitude on the part of federal agencies such as the Civil Aeronautics Board and the Federal Aviation Agency to the acute need of new technical and economic patterns to ensure success for air transport in the 1960s.

If allowed to operate in the proper economic and technical environment, we firmly believe that the jet transport will power the airline industry to new plateaus of traffic and profit in the decade looming ahead. If this proper environment fails to develop along with aggressive, modernized airline management, the jets can reverse this velocity factor and run an airline into the red faster and deeper than has ever before been possible.

The passenger, of course, is the key to the problem. If the jet transports give him what he wants—a fast, comfortable, reliable ride at a reasonable price—his demand will keep pace with the airlines' supply.

We already know that the jet transport has the capability of fulfilling these passenger requirements. But whether its economic and technical environment will restrict the full employment of this capability will be the acid test of the jet transport era.

We expect the jet also will sound taps for the current airline sales pitch to sell champagne and filet mignon as a rather poor substitute for schedule reliability. The speed and passenger capacity of the jets make elaborate meal and beverage service impractical even with a platoon of stewardesses. The biggest passenger appeal of the jets lies in their speed and comfort. But these can be quickly canceled if schedules deteriorate.

Responsibility for operational reliability must be shared today by the Federal Aviation Agency, with its airways and traffic control system, and by individual airlines with their maintenance standards and passenger handling techniques. Airline passengers are getting too sophisticated to swallow the bromides about unscheduled delays, nor can the full blame for this be placed on traffic control and weather. We recommend that airline executives mingle occasionally with a plane load of their passengers who have been dumped without notice due to equipment problems and listen to their realistic appraisal of various airlines' operational capabilities.

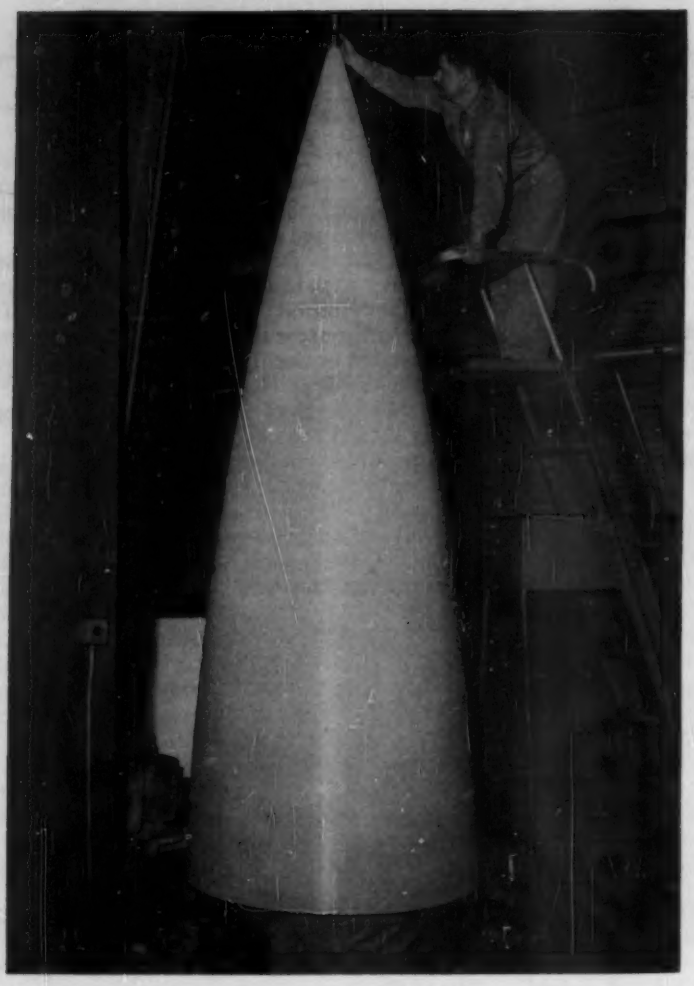
Nor can we muddle along with the same old creaking and antiquated traffic control system that has traditionally lagged a decade behind its realistic operational requirements. It will take some truly vigorous work by the Federal Aviation Agency to translate the wide variety of technical solutions to its problems already available into a high-density, all-weather traffic control system right down to automatic landing capabilities.

Fares will be another key to the future growth of airline traffic. New markets must be tapped to fill the jets' capacious cabins, and the growth of lower fare, bare-minimum service type of air transport is inevitable with the major increase in speed and individual aircraft capacity. We think a far more flexible fare structure than the fixed rate scale the CAB now envisions is an absolute necessity in broadening the airline market.

Specialized markets, such as commuter traffic between major population centers, also will prove to be a seat-filler far beyond its present magnitude and, of course, the vacation package tour is only in the early portion of its possible airline growth. Airlines must devise some more efficient techniques for handling their passengers and eliminating much of the annoying fuss and needless complexity they now endure in reservations, ticketing and checking in. Here again there are ample electronic and mechanical techniques already awaiting application to these airline problems.

The jet age is now dawning. Its initial experience has indicated a tremendous passenger demand and a profitable operation when high aircraft utilization rates and high load factors are combined. But this initial success of limited scale jet transport operations should not distract us from the formidable tasks that lie ahead in filling an additional 20 billion seat miles by 1962.

—Robert Hotz



NEW the world's biggest filament-wound fiberglass radome!

Here it is — twelve feet high, four feet in diameter — the largest filament-wound fiberglass radome ever made. This huge form was produced by a special winding process—product of Kidde engineering knowledge and research — which results in an extremely high strength-to-weight ratio, plus a maximum in physical and electrical uniformity. Furthermore, this Kidde continuous-winding process, plastic reinforced by fiberglass, permits the construction of fiberglass shapes and forms which were either difficult or impossible to fabricate by previous methods.

Walter Kidde & Company has available complete facilities and personnel for the development, testing and production of fiberglass forms. If you have a problem in this area — write Kidde today. We've solved some pretty tough ones in the last thirty years!

Walter Kidde & Company, Inc., Aviation Division
518 Main Street, Belleville 9, N. J.

Kidde

District Sales Engineering Offices: Dallas, Tex. Dayton, Ohio—St. Louis, Mo.—San Diego, Calif. Seattle, Wash.—Van Nuys, Calif.—Washington, D. C.

Walter Kidde-Pacific, Van Nuys, California
Walter Kidde & Company of Canada Ltd.
Montreal—Toronto—Vancouver

FIBERGLASS FORMS ARE A KIDDE SPECIALTY!

Thanks to Kidde's continuous winding process, a new field of fiberglass forms is now open to aviation engineers: Structural tubing, pressure vessels can now be made stronger than steel with half its weight!

For the engineer interested in the field of pneumatics, filament-wound fiberglass spheres offer the solution to many problems. Available in capacities of from 50 to 2500 cubic inches these spheres can withstand pressures up to 5000 psi.

Missile rocket motor cases, torpedo bodies and missile radomes are but a few of the forms which Kidde can fabricate from high-strength, low-weight fiberglass, capable of withstanding temperatures as high as 1000°F. for short periods of time.

WHO'S WHERE

In the Front Office

Robert W. Kerr and **Robert C. Finkelstein**, directors, Solar Aircraft Co., San Diego, Calif. Messrs. Kerr and Finkelstein are directors of Fairbanks, Morse & Co.

George T. Pew, president of Aero Design & Engineering Co., Oklahoma City, Okla., a subsidiary of Rockwell-Standard Corp., elected a director of Rockwell-Standard.

Joseph E. Otis, Jr., board chairman, Dodge Manufacturing Corp., Mishawaka, Ind. **J. Allan MacLean** succeeds Mr. Otis as president.

Donald C. Power, a director, Curtiss-Wright Corp., Wood-Ridge, N. J. Mr. Power is board chairman and chief executive office of General Telephone and Electronics Corp.

G. E. Steiner, president and a director of M. C. Jones Electronics Co., Inc., Bristol, Conn., which was recently purchased by Bendix Aviation Corp. Also: **Stanley T. Urbank**, vice president, general manager and a director.

James Allen, a corporate vice president and assistant to the president, Northrop Corp., Beverly Hills, Calif. Mr. Allen continues as a director.

Frank J. Reynolds, executive vice president, Stavid Engineering, Inc., Plainfield, N. J.

Fred J. Agnich, a vice president, Texas Instruments, Inc., Dallas, Tex. Mr. Agnich will head the company's newly formed Geo-Sciences and Instrumentation Division.

Louis H. Aricson, vice president and general manager, Daystrom Transicoil, division of Daystrom, Inc., Worcester, Pa.

C. G. Barker, vice president-sales, Filtors, Inc., Port Washington, N. Y.

G. Daniel Brewer, assistant vice president-project management and marketing, Grand Central Rocket Co., Redlands, Calif. Also: **George Staley Cushman**, director of marketing.

J. W. Evans, director, and **F. H. Moore**, technical director, Advance Planning Staff, Electronics Division, Hazeltine Corp., Little Neck, N. Y. Messrs. Evans and Moore continue as assistant vice presidents of the division.

F. T. Blakey, business manager and a special director, Bristol Siddeley Engines Ltd., London, England. **Frank Shutt** succeeds Mr. Blakey as secretary.

Honors and Elections

Capt. Stewart W. Hopkins, of Delta Air Lines, has been awarded the Civilian Flight Safety Award of the Society of Daedalians for 1958. The Daedalian Award is presented annually for outstanding performance in the line of duty.

Joseph B. Elliott, president of Tele-Dynamics, Inc., has been named chairman of the Small Business Committee of the Electronic Industries Assn., Washington, D. C.

Earl O. Olson, manager-Duluth, Minn., airport, has been named America's outstanding airport manager of the year by the American Assn. of Airport Executives.

(*Continued on page 180*)

INDUSTRY OBSERVER

► Ion engine producing 40 kw. of power and 1/10th lb. thrust (AW April 13, p. 28) will be tested in about two months at Lewis Research Laboratory of National Aeronautics and Space Administration. The engine with this thrust could be used for satellite attitude and orbit control. General Electric's Aviation Gas Turbine Division has been running a smaller ion engine since last October. It produces 1/100th lb. of thrust and 3 kw., weighs one pound not counting auxiliary equipment.

► Columbium is attracting new interest in high temperature application up to 2,500F for turbine buckets, wing leading edges and nose cones Thompson Ramo Wooldridge, Battelle Memorial Institute and General Electric all are doing work on it. It is more oxidation resistant than molybdenum and is easier to alloy to improve oxidation resistance.

► Proposals in competition for a feasibility study on a one-million-pound thrust solid propellant general-purpose booster are being evaluated by ARDC's Wright Air Development Center, which is expected to award a single contract, with no backup support. Proposals have been submitted by Aerojet-General, Thiokol, Astrodyne, Grand Central Rocket, United Research Corp., and Allegany Ballistic Laboratories. Specifications called for a single-stage unit larger than any previous solid propellant charge. Estimates are that the configuration may be as long as 40 ft. and 8 ft. in diameter.

► Army Ballistic Missile Agency is aiming to accelerate establishment, possibly by the end of the year, of an equatorial launch site in the Pacific for its Project Saturn. Navy's Pacific Missile Range organization will assist Army in implementing requirements.

► Look for North American's Mach 3 F-108 interceptor to undergo an external configuration change despite the lateness in its development stage. Internal equipment is the cause.

► USAF is looking for a new aircraft metal or alloy that will withstand both sonic pressure and heat. In examples of sonic failure involving Boeing B-52 and KC-135 jet tanker, fatigue occurred in trailing surfaces, according to Maj. Gen. A. G. Hewitt, director of maintenance engineering and deputy chief of staff-materiel. Stopgap measure is to replace conventional 75 ST aluminum skin with honeycomb sandwich type construction, posing a complicated repair job.

► Interim reports on Study Requirement 192 for establishing a lunar base with bombardment capability will be submitted to ARDC in mid-August by North American Aviation, Aerojet-General Corp., and Douglas Aircraft Corp., all of which are conducting funded studies (AW April 27, p. 26).

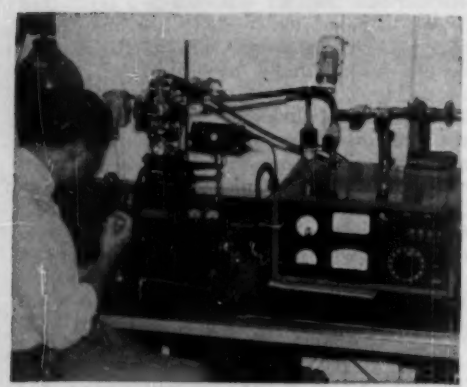
► Air Force decision on whether to proceed with development of two or three of the ballistic missile defense systems, known as Boost-Track, proposed by nine companies during a recent three-day session at Wright-Patterson AFB is not expected to be reached quickly. Companies which made proposals include: Boeing, Convair, General Electric, General Mills, Hughes Aircraft, Lockheed, Radio Corp. of America, Raytheon and Westinghouse Electric (AW Feb. 9, p. 23).

► American Bosch Arma guidance system for the USAF-Convair Atlas will not be used to guide the current D series test flights but will appear in E series tests.

► Douglas Genie MB-1 air-to-air rocket is now capable of better than Mach 4 speeds, can be delivered to North American Air Defense Command for about $7,000 each. Cost jumps to $250,000 when the nuclear warhead is installed.

► Development testing of Army's Nike Zeus is scheduled to be conducted from Kwajalein Atoll in the Pacific. Program funding now covers Fiscal 1959, 1960 and 1961.

Cutting back the Thermal Thicket



Solving high-temperature problems through research is part of Haynes Stellite's complete metallurgical services. This metallograph is used to observe metals at 2200 deg. F.

The great strength and high scaling resistance of HAYNES alloys at temperatures of 2000+ deg. F. are providing long service life in the hottest areas of jet engines. Flame holders, flame steps and afterburners are some of the hot spots where the properties of HAYNES high-temperature alloys are helping combat burnout, erosion, and stress in the jet, ramjet, missile, and rocket fields.

There are twelve HAYNES high-temperature alloys to choose from, formulated to handle virtually any heat condition. Among them: HASTELLOY alloy X with remarkable resistance to oxidation up to 2200 deg. F. HAYNES alloy No. 25 that resists stresses, oxidation, and carburization up to 2000 deg. F. And HASTELLOY alloy R-235, outstanding in the 1500 to 1750 deg. F. range. All are readily available.

HAYNES
ALLOYS

HAYNES STELLITE COMPANY

Division of Union Carbide Corporation
Kokomo, Indiana

UNION CARBIDE

Address inquiries to Haynes Stellite Company, 420 Lexington Avenue, New York 17, N. Y.

"Haynes," "Hastelloy," and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

Washington Roundup

Nuclear Plane Hearings

Rep. Melvin Price (D.-Ill.), chairman of the research and development subcommittee of the Joint Congressional Committee on Atomic Energy, is scheduling a two-day public hearing May 14 and 15 on the aircraft nuclear propulsion program. It will be the first public presentation on the program. The question is whether the Administration is willing to lift the budget ceiling and accelerate the program. Top Administration officials recently had an all-day briefing on the program by technical personnel working on the project at the Evendale, Ohio, plant of General Electric Co. (April 20, p. 25).

First witnesses will be Air Force officials favorable to an accelerated ANP: Maj. Gen. Donald Keirn, assistant deputy chief of staff for nuclear systems, followed by Secretary James H .Douglas and Gen. Thomas D. White.

ARPA Speculation

Speculation about the lifetime of Defense Department's Advanced Research Projects Agency continues (see p. 28). Latest version is that ARPA Director Roy Johnson will leave office when Defense Secretary Neil McElroy does, and that most of ARPA's scientific and technical personnel will then be absorbed by the relatively new Defense Office of Director of Research and Engineering, headed by Dr. Herbert York.

Improved Electronics

Officials of Air Research and Development Command and Air Materiel Command have begun a series of discussions aimed at developing improved management and organizational procedures for development of large electronic support systems. The result could be a major reorganization of Electronic Support System Project Offices (ESSPOs).

Ike Likes Subs

President Eisenhower was asked at his press conference last week what his position was on the desire by "some high Air Force officials" to gain "strategic control of the (Polaris) missile shooting submarines."

"Well, I think I would be with the submarines," the President replied. "I hadn't heard this story, this charge before. And, I would think that here is something that the Secretary of Defense could control and direct without—and coordinate without any difficulty."

BOAC's Tokyo Stop

Civil Aeronautics Board last week began grappling with the thorny issue of whether British Overseas Airways Corp. should or should not be granted a Tokyo stop on its around-the-world route (AW April 27, p. 38). Because Board Examiner Ferdinand Moran rested his recommended decision on very compelling reasons of public interest, the Board must weigh the public interest issue heavily in reaching its decision. At the same time, it must consider all international aspects of the case as it passes judgment on the bilateral obligations of both countries.

On the latter point, the Board moves into an area which the State Department presumably looks upon as its private realm. State has already stated its position clearly and unequivocably: BOAC should be granted the route and the stop. And State has reasoned to its own satisfaction that BOAC is entitled to the Tokyo stop under the terms of the Bermuda Agreement—the bilateral pact between U.S. and Britain. To wrap the case up so as to conform to the Administration's stand on the Tokyo stop—regardless of how the Board decides—State could conceivably prove to itself that failure to grant the Tokyo stop would be against the public interest because of the intricate ramifications involved in international relations between the two countries.

Glipar Contracts

Twelve contractors were selected last week from among approximately 30 bidders for the Guide Line Identification Program for Anti-Missile Research (Glipar) of the Advanced Research Projects Agency. Two of the 12 proposals accepted were from university groups, and the others were divided among aircraft, electronic, and related companies.

Contractors for Glipar will be: Aeronutronic Systems, Inc., Glendale, Calif.; Allied Research Associates, Boston, Mass.; the University of Chicago; Convair Division of General Dynamics, San Diego, Calif.; General Electric (Tempo), Santa Barabara, Calif.; General Mills, Inc., Minneapolis, Minn.; Hughes Aircraft Co. Culver City, Calif.; Industrial Research Associates, Baltimore, Md.; Thompson Ramo Wooldridge, Los Angeles, Calif.; Radio Corp. of America, Burlington, Mass.; Republic Aviation Corp., Mineola, N. Y., and Technical Operations, Inc., Burlington, Mass.

Renewed MATS Pressure

Military Air Transport Service intention to increase its own operations and buy less commercial airlift for Fiscal 1960 may bring renewed pressure for enactment of legislation to limit its worldwide operations. Commercial airlines have often criticized MATS as operating a huge airline, in direct competition to commercial carriers in many instances, and have called for greater utilization of the airlines in the carriage of military traffic. Congress last year in the appropriation bill made available $80 million to be used only to buy commercial transportation to supplement MATS. Witnesses told the House Defense Appropriations Subcommittee this year that only $66.7 million of the $80 million had been spent with commercial carriers and that only $54 million is programed for Fiscal 1960.

'Fifth Wheel' Committee

The Civilian-Military Liaison Committee, created to "advise and consult" on aeronautical and space matters that concern the National Aeronautics and Space Administration and the Defense Department, is "strictly a fifth wheel" and "nothing more than a post office," Chairman William A. Holaday told a Senate space subcommittee.

Holaday said he is drafting proposals that would strengthen his committee's position so it can make a real contribution to the nation's space effort. The subcommittee, headed by Sen. Stuart Symington (D.-Mo.), is looking for wasteful duplication in space programs. Holaday said he knows of none at the present.

—Washington staff

U.S. Airlines May Hit Record Earnings

New economic study indicates airline growth trend will parallel an increase in U. S. gross national product.

By L. L. Doty

Washington—Sharp upsurge in passenger traffic during the first quarter of the year now indicates that 1959's net earnings for the domestic trunkline industry may top the previous high of $63 million reported for 1955.

Latest forecast, an upward adjustment from the $43 million net earnings predicted earlier this year (AW Mar. 9, p. 35), is based on the recent revival of the industry's historic growth trend which came to a virtual halt in 1958. It is also based on a new economic study which shows that airline traffic peaks and valleys closely parallel upward and downward quarterly swings in the gross national product.

If the general economy holds to its upward trend throughout the balance of the year, as most economists predict it will do, revenues for the year will show one of the sharpest gains in airline history. Degree to which the climb in gross revenues will be reflected in net profits depends on the inflationary factor—the rising cost of doing business.

Trunkline Picture

Here is the general economic picture as it is related to the trunkline industry:

• **Trend toward higher revenues,** wider profit margin was set in the first quarter. Delta Air Lines is expected to report it earned more in the first quarter than in any other three-month period except the final quarter of 1958, when the net exceeded $2 million. United reported a $1.8 million first-quarter profit compared to a loss in the first period last year. Both Trans World Airlines and Capital made sharp cuts in first period net losses compared to last year.

• **Business travel will climb.** Close relationship of business travel to the gross national product gives strong assurances of continued growth in this travel category. The gross national product stood at $460 billion at the end of the first quarter, a 14% increase over last year and only slightly short of the $470 billion earlier predicted for December 1959. Recently, Woodlief Thomas, economic advisor to the Board of Governors of the Federal Reserve System, forecast a 5% rise in the gross national product during the year.

• **Personal travel will grow** during the year. Such travel is geared to personal income and discretionary spending power according to recent surveys. Consumer spending during the first quarter reached $300 billion at an annual rate, highest level attained for a three-month period. Treasury Department is estimating that 1959 personal income will reach $374 billion—up $20.5 billion over 1958.

• **Expansion of turbojet** and turboprop aircraft is expected to generate new sources of traffic (AW April 20, p. 39). According to American Airlines' President C. R. Smith, the new equipment will "manufacture" air transportation with economy.

• **Inflation trends** appear to have been arrested, at least temporarily. Airline costs will continue to climb, due primarily to interest rates on loans for new equipment and transitional costs of the turbine aircraft. However, if inflation is checked to some degree, the rise in costs may not be so marked.

• **Normal expansion of operations** will boost labor costs slightly but, with most labor contracts now settled through 1960, any major strikes that would touch off a new spiral of wage levels are not expected this year. In general, labor costs, a major factor in the over-all expense level, probably will remain relatively stable throughout the year.

• **Washington observers** now feel that the 4½ cents fuel tax proposed by President Eisenhower has little chance of passing Congress this year. It has been estimated that such a tax would cost the airlines approximately $86 million in Fiscal 1960.

• **Unknown factor** in the general outlook for airline business is the passenger fare issue. Most airline financial experts feel that although revenues will reach new highs this year, amounts carried through to net earnings will not be proportional unless rates are increased by the Civil Aeronautics Board.

Prospects that gross revenues for the domestic trunkline industry will exceed $1.8 billion are now bright. This would represent an increase of about 15% over the all-time high of $1.5 billion reported by the industry in 1958.

Last year, expenses also climbed to a new high—$1.4 billion. Result was a total net profit of $44 million, a decided jump over the $27 million report the previous year but far short of the earnings deemed necessary by the industry to bring about jet operations successfully and economically.

If costs in 1959 are held to a 10% increase, chances are strong that net profits in 1959 may go as high as $75 million, even without a passenger fare increase.

This estimate is based on the assumption that most carriers will continue to use the seven year depreciation policy on new equipment. Revenues for the year are projected on the present fare level.

Adjustment in rates will have a strong effect on both revenues and earnings. For example, United Air Lines has reported that the 6½% increase granted in February, 1958, and subsequent rate revisions boosted last year's gross revenues by approximately $14.5 million.

Expanding Economy

The forecast also is projected on the wide-spread theory that the general economy will continue to expand throughout 1959. Future growth is borne out by such factors as increases in general industry's capital expenditures.

Capital expenditures, which declined steadily last year, moved from an annual rate of $31.1 billion during the first quarter to a $32.9 billion annual rate committed through the second quarter. Expenditures for plant and equipment may reach $34.2 billion by the end of the year, a 7% increase over last year.

Of chief interest to the trunkline industry is the gross national product index which is rising spectacularly. The close parallel between the gross national product and passenger revenue miles is now providing airline economists with an effective measuring rod in projecting future plans.

However, in tracing the relationship between gross national product and airline business, two deviations show up in past patterns which leave some margin for error in predicting future trends.

First deviation stems from airline strikes, major industrial strikes such as a prolonged steel strike and highly publicized midair collisions. During the past eight years, airline traffic has reacted violently to such aberrations despite the status of the general economy.

For example, airline business activity fell off sharply from the gross national product index immediately following the Grand Canyon midair collision in June, 1956, although business generally was especially stable at the time.

Second deviation, which apparently has no explanation, shows that airline business dipped abruptly during the 1954 recession two months in advance of the drop of the gross national prod-

NATIONAL AIRLINES showed a 20% increase in traffic during March, began New York-Miami Lockheed Electra service April 26.

uct. And it trailed the gross national product by about two months in recovering from the decline.

However, in the 1957-58 recession, the gross national product preceded airline business in its decline by about two months but airline business recovered well ahead of the gross national product. Airlines are watching consumer spending as a second important index in determining traffic trends.

Generally, the trunkline industry is moving into the transition to turbine-powered equipment in a relatively strong financial position. Current ratios at the end of 1958 showed a substantial improvement over previous periods and in many instances are edging close to a healthy 2-1 ratio, although CAB accounting changes contributed some artificialities to these.

Actually, working capital positions are normally stronger than corporate balance sheets indicate because of the necessity of including air travel subscribers' deposits as a current liability. Although this item is theoretically a current liability, it is, in fact, a long-term liability since it is never drawn upon in significant amounts.

Eliminating the subscribers' deposits entry of $9.9 million in American's statement, for example, would give the carrier a straight 2-1 current ratio. Eastern reported a 2½ ratio. Both Western and Braniff showed strong current ratios.

Ratio of market value of common stock to book value also has improved significantly to provide carriers with a stronger base for refinancing than has previously been possible.

Last year at this time, only two airlines—American and Northeast—had common stock selling at a higher price than the book value of the stock and these ratios were only fractional. This year, according to April 28 listings on the New York and American Stock Exchanges, all but a few airlines are showing a strong ratio of market to book value of their shares outstanding.

A number of carriers can be expected to follow American's lead in taking advantage of the current economic situation for further financing. Prior to announcing its plan to take out new loans totaling $70 million, American spelled out its philosophy in this respect when the company's Executive Vice President-Finance, William J. Hogan, said:

"Many of the elements entering into future cash flow are difficult to evaluate precisely. . . . In view of such uncertainties, prudence indicates the desirability of a strong cash position and an adequate equity base. It may be, therefore, that if the security market continues on the strong side we would take advantage of the situation and obtain some additional financing, despite the fact that our entire equipment program has already been financed."

Heavy Activity

Although airline listings are recently experiencing heavy activity and irregular strength in price, such stocks are not attractive from an earnings standpoint and are considered by many traders as highly speculative. In addition, conservative brokers have indicated there is a high degree of speculative activity in the market that should be watched with caution. Keith Funston, president of the New York Stock exchange, also has warned against uninformed speculation.

What effect these notes of warnings, if continued with increasing stress, will have on the investor remains to be seen. It is quite possible he will continue to look upon airline listings as growth stocks—particularly in view of the introduction of jet equipment this year.

The fact remains, however, that airlines must show a strong earning position if a healthy relationship between market price and book value is to be stabilized.

Progress in this direction is promising. During the first quarter, Northwest Airlines recorded a first-quarter profit for the first time in its 32-year history. The company's net income of $93,564 during the period compares with a net loss of $795,000 in the first quarter of 1958.

Operating revenues climbed 44% and expenses were up only 31%. Operating income totaled $639,000—an improvement of $2.3 million over the first quarter of 1958.

Western Air Lines reported a net profit for the first quarter of $1 million. Last year, the airline suffered a four months strike that began Feb. 21 so that comparative data is unrealistic.

National Airlines showed a first quarter profit of $1.6 million—an 81% increase over net earnings of $586,000 in the same period last year. Gross revenues were up 24%. Eastern reported a $2.1 million profit for the period, despite a slow January recovery from a 39-day pilots' strike at the end of the year.

American reported a net loss of $1.9 million for the first three months and a 2% decline in revenues for the period. However, C. R. Smith, American president, estimated that revenues would have been $79 million instead of the $69.4 million had it not been for the pilots' strike early in the year.

Trans World Airlines reported an 18.6% increase in revenue and held expenses to a 6% increase for the first quarter of 1958 compared to the same

period last year. Net loss for the period was reduced to $3.7 million from the $10.4 million reported in the same period last year.

Capital cut its loss for the first quarter to $936,800 from $1.5 million in the corresponding period last year. Operating revenues climbed 13.4% while operating expenses were held to an 11.4% increase.

Delta Air Lines' revenues during the first quarter reached $27 million, a 17% increase over last year.

Cargo revenues rose 22% in the same period.

Todd G. Cole, Delta executive vice president-administration, told AVIATION WEEK that the company's revenues were "aided by passenger fare adjustments" and added: "our over-all expanded volume of business can be attributed in part to the effects of strikes experienced by several of our competitors and to the nation-wide economic upturn."

The company is expected to report a substantial net profit for the first-quarter period.

Continental Airlines reported a $230,000 net profit compared to a $240,000 net loss in the first quarter last year. Expenses were up 31%, revenues climbed 38%.

Space Technology

Gen. Schriever Asks ARPA Abolishment

By Ford Eastman

Washington—Existence of Advanced Research Projects Agency threatens to delay introduction of space weapons into an operational inventory, Congress was warned by Lt. Gen. Bernard A. Schriever, commander of Air Research and Development Command, USAF.

The newly-appointed head of ARDC said he felt that ARPA, as an operating research and development agency, should be abolished at the end of the current fiscal year and that policy direction, guidance and program approval should be applied to the services by the office of Director of Research and Engineering.

Gen. Schriever also criticized the delay in assigning operational responsibility of projects under development to the services and, at the same time, he said he felt the Air Force should have the predominant role in space.

Testifying before the Senate Subcommittee on Governmental Organization for Space Activities headed by Sen. Stuart Symington (D.-Mo.), Gen. Schriever said the key factors in reducing lead time between technical feasibility and useful operational systems from an organization, management and administrative standpoint, are:

- **"The primary user** should be designated as the operating service upon initiation of a weapon system development program, and should be assigned management control of both development and operation of the system.
- **"Proper relative priority** should be maintained between military and non-military projects.
- **"Proper integration and control** of military and non-military scientific efforts and resources should be assured.
- **"Mission areas for each** of the services should be clearly defined.
- **"The service responsible** for system development should be delegated clear authority and should be given the resources necessary to do the job.
- **"Authority, responsibility,** and resources should be placed by each service at the lowest operating management level where all factors of program implementation can be controlled and integrated on a concurrent basis.
- **"Administrative channels** from the operating management agency to the top policy and approval level must be clear, direct and short.
- **"Budget limits** should not be arbitrary, and in the case of space development, cannot be applied to space as a separate and distinct entity per se."

Gen. Schriever said the critical importance of achieving space weapon capability for national survival requires that every effort be made to compress lead time to a minimum. It is impossible, he added, to plan, program, budget and implement on a completely integrated basis the way the military space system is set up at present.

ARPA, he explained, has the development responsibility of all space systems within the Defense Department. It can assign the program to a service to carry out or it can divide it among services. However, ARPA retains project direction and no one service is given the over-all management responsibility for the program, nor has the mission responsibility been assigned to date, he testified.

This separates the development element of the over-all weapon system from other aspects such as logistics, production, training and operational facilities, according to the General.

When the current military space programs were initiated, he said, none of the elements of the total weapon system was in existence. Therefore, to compress time it will be necessary

ARDC Policy Change?

Lt. Gen. Bernard A. Schriever, new commander of USAF's Air Research and Development Command, last week began a two-week tour of the command's nine centers amid strong speculation that he will make extensive changes in ARDC policies and structure.

Although he is expected to write his own program to a great degree, he probably will draw a number of ideas from the still-unimplemented report made almost a year ago by the ad hoc Stever Committee of the USAF Scientific Advisory Board (AW July 14, p. 29 and July 21, p. 23). This report urged a number of changes in USAF research policy and operations procedures, both above and within the command.

Many of the recommended changes were aimed at reversing what the committee called "a growing lack of trust in the capability and performance of individuals at the working level in research and development." Gen. Schriever is expected to move to ARDC headquarters at Andrews AFB, Md., the week of May 25.

Space Weapon Systems

Washington—Major space weapon systems which USAF considers necessary for military space operations of the future, Lt. Gen. Bernard A. Schriever, commander of Air Research and Development Command, told a Senate Space subcommittee, are:

- **Offensive weapons—Advanced strategic missile systems and manned strategic space system.**
- **Defensive weapons—Anti-missile defense system (early warning and extensions), satellite defense system, satellite inspection system and manned defensive space system.**
- **Reconnaissance systems — Reconnaissance satellite weapon system and infrared subsystem (alert system), visual reconnaissance subsystem and mapping and charting subsystem.**
- **Supporting systems—Communication satellite, environmental observing and forecasting system, space navigation system, specialized test vehicle, integrated ground acquisition and tracking system and logistic support systems which include recoverable boosters (prime movers), maintenance and resupply and space transportation system.**

to adopt the essential principles of the management concept of concurrence, wherein each element of the total weapon system is integrated into a single plan, program and budget, and is implemented concurrently, consistent with lead time requirements. It would be costly in time to develop the various subsystems first, he said.

Gen. Schriever said weapon system development based on technical feasibility requires that the military:

- "**Conduct a vigorous research,** applied research, component, and subsystem development program.
- "**Conduct constant evaluation** and analysis of the programs, aided by science and industry, to insure timely initiation of space weapon system development programs.
- "**Centrally manage and control** space weapon system programs to insure effective systems engineering, integration and testing, which is essential to the intricate technical interface between and among the several subsystems comprising the total weapon system."

The ability to apply this philosophy of weapon system initiation to space vehicles will be complicated if there is an excessive division of subsystem development projects among agencies or if there is not a timely decision as to the military operator.

Military Role

There is a clear military role firmly attached to space weapon systems now under development, Gen. Schriever said. These systems include the long range ballistic missiles, the reconnaissance and early warning satellites as well as communication, weather, navigation and mapping and charting satellites.

While there isn't any question that space will provide all three services with the ability to do their jobs better, particularly in the support areas, Gen. Schriever added, it will be the Air Force's primary combat mission that will be the most vitally affected.

He said the actual combat role of the Army will not be changed by space because the foot soldier will still be needed to occupy land, and the Navy is going to continue to have ships on the surface and underneath the ocean. However, by 1970 and perhaps long before that, he said, the strategic and air defense missions of the Air Force will be taken over by space weapon systems—ballistic missiles, satellites and spacecraft.

"I think it is clear that our responsibility under the National Security Act is that we provide the systems that will best do the strategic and air defense job," Gen. Schriever emphasized. "Unless the Air Force is clearly given this mission to do, we might very well end up being largely an air transport or logistical service."

High Intensity Radiation Produces Convulsions, Death in Monkey

Washington—Recent experiments by National Institute of Health show that close-range exposure of the brain of a monkey to high intensity radio waves can produce convulsions, and five minutes continuous exposure can cause death.

First details on the experiments conducted in March were revealed by Dr. Pearce Bailey, director, National Institute of Neurological Diseases and Blindness, in budget hearings before House Appropriations Subcommittee.

Dr. Bailey speculated that the discovery of possible brain damage from radio/radar waves might explain "mysterious airplane accidents." However, avionic experts point out that a metal fuselage acts as an effective shield and that aircraft operate at considerable distances from powerful radars which further attenuates their energy intensity.

Brain disturbances in the presence of high intensity radiation also have been observed recently in mice, chickens and dogs by scientists at Rome Air Development Center, AVIATION WEEK has learned. RADC tests are part of a program to assess biological damage due to electromagnetic radiation and to establish safe limits for human exposure. It has been known for some time that high internal body temperatures can be produced by exposure at close range to high intensity radar energy, not unlike the controlled effect produced by short-wave diathermy machines for medical use.

In the experiments, the monkey was fastened to a chair in a sitting position inside a drum-shaped cage which served as a resonating cavity to greatly strengthen the electromagnetic energy within the cage. A radio antenna fitted to the top of the cage pointed toward the monkey's head, in line with his brain stem—the central vital portion of the brain. Antenna was excited by an AN/GRC-27 ultra frequency transmitter which operates in the 225 to 400 mc. range, has a peak output of about 100 w.

When the transmitter was turned on, the monkey was apparently unaffected for a few seconds, then it became drowsy. After a minute or so, Dr. Bailey

X-15 Cockpit Mockup Shows Location of Controls

Mockup of the North American X-15 rocket research aircraft was displayed at the Air Force Assn.'s World Congress of Flight in Las Vegas, Nev. The mockup has a wrist control stick on the right-hand side (not visible) for conventional aerodynamic control. Center stick moves simultaneously with it. Center stick is installed for landing because pilots are accustomed to using a stick during landing. A semi-wrist-motion control is on the left side of the cockpit; it is used for ballistic control and activates small jets for out-of-atmosphere control. This control operates up or down or left or right. Oxidizer and fuel tanks are trimmed with jettison trim control (toggle switch above ballistic control) which trims the center of gravity of the plane and also controls jettisoning of fuel. Sideslip, roll and pitch instrumentation (center of panel) is required for the flight test program to get accurate settings for these regimes, since the conventional ball indicator does not give a close enough reading. This mockup differs somewhat from the actual X-15 cockpit.

said, the monkey became agitated, moving its head from side to side. In another minute there appeared "unmistakable signs of some impending disturbance in the vital centers of the brain, which were probably resonating with these electromagnetic waves," Dr. Bailey said. Finally the monkey was thrown into a major convulsion a few seconds before death occurred.

Examination of the brains of 10 monkeys which died in the experiments revealed no pathological cause of death, Dr. Bailey said. Another 10 monkeys, whose exposure was cut short of death, showed symptoms which resembled those of Parkinson's disease in humans. Most survivors recovered completely.

Dr. Bailey said the discovery of brain effects offers great possibilities as a new research tool in brain research and ways of developing improved devices to protect against electromagnetic radiation.

Rome Air Development Center tests have been run with radiation intensities of up to one watt per square centimeter on the test animals, approximately 100 times the maximum dosage considered safe for humans. Tests have been conducted over a wide range of frequencies, from approximately 200 mc. to 27,000 mc. All test animal deaths to date have resulted from hyperthermia—excessive internal body temperature.

Although high intensity radiation exposure has produced mental disturbance in the test animals, RADC scientists have succeeded in training some of the animals to perform normal tasks despite the radiation. RADC has an extensive radiation biology program under way at a number of universities, including Buffalo, California, Iowa, Miami, Pennsylvania, Rochester, Tulane and Tufts.

Snecma Arranging For J75 Production

Paris—The state-owned engine manufacturer Snecma and Pratt & Whitney are ironing out details of a deal under which Snecma would manufacture J75 jet engines under license (AW Feb. 9, p. 23).

The engines would be used in the production version of the Mirage IV bomber (AW April 27, p. 27) slated to make its first flight in the spring of 1961, and possibly in a Super Caravelle with 90-100 passenger capacity.

The deal involves financial participation by Pratt & Whitney. Although Snecma officials would not disclose what arrangements were being discussed, one indicated that Pratt & Whitney would get some—probably less than 20%—of Snecma's stock, now owned by the French government.

Snecma recently signed an agreement with Pratt & Whitney to maintain and overhaul J75s in Europe.

NASA Tests Project Mercury Escape System

Escape system of the Project Mercury manned orbital capsule is tested at National Aeronautics and Space Administration Pilotless Research Station, Wallops Island, Va. Escape rockets carried a full-scale one-ton "boilerplate" model of capsule to 2,250-ft. altitude. Tripod then separated and capsule parachuted into water and was recovered by helicopter.

AIA Attacks Renegotiation Board Policy

By Katherine Johnsen

Washington—Aircraft and electronics manufacturers last week called on Congress to prevent the Renegotiation Board from wiping out the incentive profits they earned under contracts with the military services.

William M. Allen, president of Boeing Airplane Co., testifying on behalf of Aircraft Industries Assn., told the House Ways and Means Committee that renegotiation "as currently administered is destroying incentives and depleting the strength of industry so essential to the effective fulfillment of our national defense objectives." The committee is considering extension of the Renegotiation Law, which expires June 30.

Pointing out that Renegotiation Board has repeatedly recaptured from aircraft manufacturers amounts equal to or in excess of their incentive awards from the military services, Allen charged that "the Board has assumed the prerogative of passing judgment on what is the proper profit level for the aircraft industry as a whole."

Awards Nullified

AIA presented these examples to show that Renegotiation Board nullifies incentive awards:

• **Boeing had $25 million** in incentive earnings over three years. The Board ordered a refund of $27 million for the period.

• **Lockheed Aircraft Corp.** earned $12 million in incentive payments for two years, but was ordered by the Board to refund this same amount for the period.

• **North American Aviation** had $23 million in incentive earnings over three years, but was ordered to turn back $29 million for the period by the Board.

• **Douglas Aircraft Co.** had incentive earnings of $2.7 million over two years, but was ordered to refund $12 million for this period by the Board.

Three positions as to what the future of renegotiation should be, each with substantial support, were presented at the Ways and Means hearings:

• **Legislation sponsored** by Rep. Cecil King (D.-Calif.) which would restrict Renegotiation Board's authority to recapture profits, requires the Board to furnish contractors more extensive information on the basis for its determinations, and give contractors the right to appeal renegotiation determinations from the U. S. Tax Court to the U. S. Court of Appeals, was endorsed by AIA and Electronic Industries Assn.

• **Department of Defense** acquiesced in two changes in the law. These would require the Board, by statute, to give consideration to the incentive pricing provisions of contracts and permit contractors to appeal to the U. S. Court of Appeals.

• **Rep. Carl Vinson** (D.-Ga.), chairman of the House Armed Services Committee, denounced all proposed changes and recommended that renegotiation, as is, be made permanent law. The King bill and Defense Department proposed a two-year extension.

Vinson Statement

"For practical purposes," Vinson told the committee, "none of the proposed amendments to the existing law [is] for the benefit of the government. They are only for the benefit of the private contractor. . . . If there were an equity on the side of the contractors in any of these amendments, then I would not oppose them. . . ."

Vinson reported that of a total $81.8 million of excess profits determinations by the Renegotiation Board being contested in the Tax Court, seven aircraft companies account for more than $72.1 million. He said these are: Boeing, $26,799,828; Douglas, $8,758,630; Lockheed, $4,254,978; Martin Co., $3,162,759; North American, $17,682,616; Temco Aircraft Corp., $4,844,000; and Grumman Aircraft Engineering Corp. $6,665,000.

Vinson charged that "these are the holders of incentive contracts who would have them specially protected in the legislation proposed by the Department of Defense." Opposing authority to appeal to the Appeals Court, Vinson declared that "the recovery of profits ought not to be accomplished by requiring the government to win the cup three times, before obtaining permanent possession. . . . When the Board has made its determination on the question of the fact of excessive profits, and that decision has been formally reviewed by the judges of the Tax Court . . . anyone would be satisfied that there has been substantial evidence to sustain the facts found.

"The Appeals Court could do little more thereafter than frustrate the whole proceedings."

AIA Support

Following are provisions of the King bill supported in AIA's presentation:

• **Profits agreed upon** between the contractor and the military service, plus up to 10% additional in incentive payments, would be exempted from renegotiation. AIA endorsed this "in view of the fact that 'agreed profits' are based upon the minimum amounts which the parties contemplated at the time they entered into the contract. and further because we believe that a contractor should be permitted to retain some portion of any additional profits he may be able to earn through efficiency and cost reduction. . . ."

• **Board would be required** to consider the stability of defense industry in recapturing profits. "The aircraft in-

Similarity of Profit Percentages

(Compiled by Boeing Airplane Co.)

	Renegotiation Refunds (Before Taxes)	Ratio of Earnings to Sales (Before Federal Income Tax)		Ratio of Earnings to Sales After Renegotiation and After Federal Income Taxes
		Before Reneg.	After Reneg.	
Boeing Airplane Co.				
1952	10,000,000	7.60	6.30	1.9
1953	7,500,000	7.06	6.30	1.9
1954	10,000,000	7.20	6.31	3.0
North American Aviation, Inc.				
1953	6,000,000	7.39	6.46	2.1
1954	14,000,000	8.59	6.56	2.9
1955	9,000,000	7.70	6.63	3.2
Lockheed Aircraft Co.				
1953	6,000,000	6.90	6.17	1.9
1954	6,000,000	7.17	6.30	3.0
Douglas Aircraft Co.				
1953	6,000,000	6.39	5.65	1.7
1954	6,000,000	6.39	5.64	2.6

dustry as a whole, as well as a given company within that industry, is perhaps more susceptible to fluctuations in business than any other," AIA commented. "All we ask is that the Board give consideration to this factor. . . ."

• **Board would have to give** contractors the evidence it considered in arriving at a determination of excess profits. "At present the Board refuses to make known to the contractor the evidentiary basis, or lack thereof . . . .," AIA declared. "It would seem to be nothing more than elemental fairness to require the Board to make a full disclosure of the facts. . . ."

• **Board would have** to give Congress annually a detailed report on each proceeding involving more than $20 million of renegotiable business. AIA said this would furnish contractors "with a source of much needed information" which they could use in their own renegotiation proceedings.

• **Tax Court would be directed** not to assume that the Board's determination is correct in its review, leaving the burden of proof to the contractor. "The Tax Court appears to proceed on the assumption that the Board's determination of excessive profits is correct and has several times sustained such a determination on the ground that the contractor has failed to prove it wrong," AIA said.

Burden of Proof

Renegotiation Board pointed out to the committee that the burden of proof is placed on the contractor by regulations of the Tax Court. Thomas Coggeshall, Board chairman, commented that "this is the traditional principle of Anglo-Saxon jurisprudence that the burden of proof rests upon the moving or petitioning party. . . . The petitioner in a renegotiation case in the Tax Court is the contractor."

Coggeshall challenged the profit formula of the King bill—"agreed profit" plus 10% additional—"specifically, on the basis of actual experience, would have the effect of exempting all, or virtually all, the large profits realized by the members of the airframe industry. . . ."

In addition, he objected, "it would delegate to contracting officers all over the country the power to decide the extent to which profits shall be exempt from renegotiation."

In the case of subcontracts, he declared the situation would be "infinitely worse," since the "agreed profit" would be arrived at by two private individuals —contractor and subcontractor. "This would amount to a capricious and wholly unsupportable delegation to private individuals of the authority of the Congress to exempt profits from renegotiation."

Defense Department Opposes Bill Calling for Single System Manager

Washington—Department of Defense is opposed to widespread use of a single weapon system prime contractor in military procurement.

This is a key feature of comprehensive procurement legislation, sponsored by Sen. Leverett Saltonstall (R.-Mass.), aimed at cutting lead time on advanced weapons production by decentralizing authority and responsibility and cutting red tape (AW Aug. 18, p. 26). The measure provides for a single "system manager," designated by the secretary of the service letting the contract, and a single prime contractor—unless there is good reason for an alternative type of procurement.

In a report on the Saltonstall legislation to the Senate Armed Services Committee, Robert Dechert, Department of Defense general counsel, said, in effect, that the department should have a free hand to select whatever type of procurement it might consider suitable.

"No single method of formula provides an answer to the management or procurement of weapon systems," Dechert stated. "The nature of the item, the state of the art, the 'in-house' or contractor capability, the degree or urgency, differ from weapon system to weapon system. . . . To emphasize a single weapon system manager, on one hand, and a single prime contractor, without recognizing capability within the government itself, or of other contractors is unduly restrictive. In this period of evolution, flexibility of approach is essential."

He pointed out that, particularly in the missile field, the department prefers several prime contractors—one for assembly and one for each major subsystem—with "no one contractor, in reality, a weapon system contractor."

Major Contractors

Meanwhile, two major defense contractors endorsed the Saltonstall provision for encouragement of single-manager and single prime contractor, in testimony before the Senate Small Business Committee:

• **Frank L. Dobbins,** director of materiel of Boeing Airplane Co.: "The concentration of management responsibility, both within the procuring agency and within industry, which is the significant feature of this method of procurement, can, we believe, significantly expedite the development and delivery of advanced weapons of increased quality at a reduction in cost."

• **C. W. La Pierre,** vice president of General Electric Co.: "I am definitely in favor of procuring complete defense systems from a single prime contractor who will have over-all responsibility for the design, development, and production of the system. In saying this, it should be known that General Electric is more often a supplier of major components than we are a prime contractor of systems."

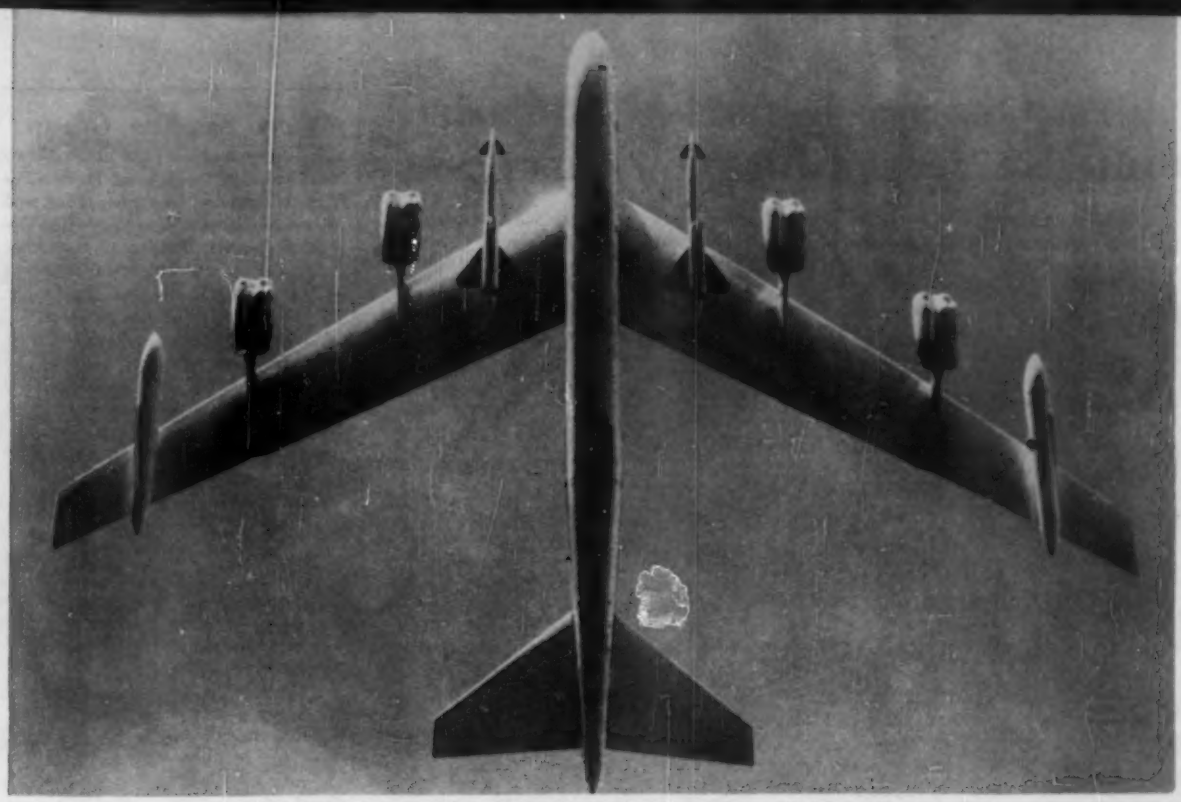
These are the positions taken on other provisions of the Saltonstall bill:

• **Elevation of "competitive** negotiation" to equal status with advertised procurement. At present, negotiation can be used only when advertised bidding is impossible. This change was urged by the Department of Defense, as well as the two industry spokesmen. "There is a serious misconception in the public mind that competition is obtained only under formal advertising," Dechert commented.

• **Use of "performance specifications"** instead of the elaborate detailed specifications now required in contracts. La Pierre declared that "broad performance specifications is the only effective way of purchasing the highly technical modern defense equipment." Dechert and Dobbins recommended that the type of specifications be left optional to suit the type of procurement. "There are many occasions when the use of design specifications or a combination of both design and performance specifications will best serve the interests of the government," Dechert commented. Dobbins cautioned that there are cases "where a performance specification would be far more complex than a description of the physical details of the item."

• **Provide "set-asides,"** exclusively for subcontracting with small business, in prime contracts. Dechert pointed out that it might be "an administrative burden to designate particular items for set-asides. . . . and delay performance." Dobbins said that "competitive bids should be secured from both large and small business in order to ensure that we obtain the best quality and the best price available." La Pierre commented that "these tremendous systems are not easy to build, and any dictation of how it is to be done and who is going to be used, will detract from the flexibility that a fast-moving technology requires. . . ."

• **Exempt fixed price,** formally advertised and incentive-type contracts from renegotiation law (see p. 31). Dobbins said that this "represents one constructive approach to one important aspect of the renegotiation problem."



Hound Dog Undergoes Operational Testing

Two USAF-North American Aviation GAM-77 Hound Dog air-to-ground missiles are mounted on pylons beneath wings of a Boeing B-52 Strategic Air Command bomber. Hound Dog, in operational test phase, is powered by Pratt & Whitney J52 (7,500 lb. thrust).

Space Technology

Soviets Plan Surveillance Satellite Launch

Washington—Russia plans to pursue three major space exploration programs simultaneously "in the nearest future," according to an article by Prof. G. V. Petrovich in an official publication of the USSR Academy of Sciences.

The three concurrent programs which are projected for years ahead concern:

• **Earth satellites** of varying weights and purposes. The first satellites of the new program will be designed to keep the entire earth and space near the earth under constant observation and they will be launched into approximately polar orbits. Prof. Petrovich has stated that the instrumentation will include such devices as optical and television apparatuses.

• **Recovery of the satellites** or their essential parts with and without the use of wings, is an objective of the program. First instruments, then animals and finally men will return to earth from space in such vehicles according to Soviet plans. Once this has been accomplished the Russians plan "full fledged, well equipped" satellites and a space station for more detailed observation of the earth and space and later to act as servicing stations for interplanetary vehicles. Planned altitudes of the satellites vary from a few hundred miles for the first units designed for earth observation to tens of thousands of miles for the space stations.

• **Moon exploration.** First vehicle in this program was "Mechta" launched last Jan. 2, which Prof. Petrovich claims came within 3,107 to 3,728 mi. of the moon. Subsequent flights will circle the moon, photograph the back side and transmit the picture to earth. Some of the later exploration rockets will be placed into orbit around the moon. These and others which are satellites of the earth will be used to map space within 300,000 mi. of the earth. Soviets plan to place scientific instruments on the moon before manned flights are attempted. Prof. Petrovich said that landing of men for a direct study of that body is a "logical and unavoidable event." First manned lunar flights would only circle the moon and return to earth. The Russians believe that they will be able to land instruments and men on the moon virtually without impact and in precise locations, using retrorockets. To relieve the strenuous design problems for multistage manned rockets, powered by presently known chemical engines, which can take off from the earth, land on the moon and return to earth, the Russians plan to store fuel on the moon before men land there. Fuel containers would be dropped from unmanned rockets. The stored fuel would allow a lighter moon landing vehicle to be used and would be necessary for the return trip to earth. The Soviets would increase the probability of a successful trip to the moon by sending two rockets together so that the crews could return to the earth together in the event that one of the vehicles experienced a catastrophic failure.

• **Interplanetary exploration.** Preparation for unmanned reconnaissance rockets to Venus and Mars is considered feasible now by the Soviets and they intend to come as close to the target planet as possible. These first flights will travel along a minimum energy trajectory so that a maximum load of scientific equipment can be carried.

First Quarter Reports Emphasize Intense Search for New Business

Sales and profits were off for Chance Vought Aircraft, Inc., in the first quarter this year, but company officials told stockholders at the annual meeting that 1959 is still expected to be the company's second best year.

The company has mounted a substantial sales effort to get new business to replace the canceled Regulus II and F8U-3 programs. Award of the Project Scout airframe contract was one result of this continuing effort.

Sales in the first quarter totaled $66,295,732 and net profit was $1,506,023. This marks a decline from sales of $78,401,110 and net income of $2,312,451 for the same period last year. Earnings amounted to $1.27 a share in the 1959 quarter compared with $2.12 on approximately 10% fewer shares in the first quarter last year.

Working capital at the end of the three-month period was $39.5 million. Credit line arranged for the year ending Mar. 31, 1960, is $30 million.

The Project Scout contract represents Chance Vought's first hardware commitment in the astronautics field, an area the company regards as one of its future major interests. The contract also brings the company a new customer, National Aeronautics and Space Administration, and if the Air Force makes substantial use of the Scout vehicle, it will represent Chance Vought's first major USAF business. In addition to the Scout contract, Vice President-General Manager R. C. Blaylock told stockholders that Chance Vought has five major proposals pending and that the company intends to go after the world-wide tracking facilities project for Project Mercury, teaming with "a strong partner."

Other financial reports:

• **Bell Aircraft Corp.** reported first quarter sales declined 39% compared with the 1958 period. Earnings were $690,721 or 26 cents a share on sales of $29,093,532. The earnings figure was an 11.6% decline from last year's first quarter.

• **Republic Aviation Corp.** sales rose from $35,831,275 in the first 1958 quarter to $53,105,700 this year, but earnings for the same period dropped from $702,209 or 48 cents a share to $581,940 or 40 cents a share.

• **Martin Co.'s** first quarter earnings were $3,038,479 or $1.04 a share on sales of $122,159,105. This was a sharp increase over first quarter figures for 1958—earnings of $1,693,000 or 58 cents a share on sales of $96,361,490—but was in line with figures for the latter part of last year.

• **American Bosch Arma** first quarter sales rose to $31,177,327 compared with $27,018,890 for the same period a year ago. Earnings rose 62%—from $886,708 or 46 cents a share to $1,444,995 or 76 cents a share. Defense backlog was $196 million.

• **McDonnell Aircraft Corp.** in the nine months ended Mar. 31 earned $7,030,644, or a margin of 2.1% on sales of $328,690,254. Earnings were equal to $4.27 a share. Comparable figures last year were earnings of $6,681,299 or $4.06 a share on sales of $321,993,672, also a 2.1% profit margin.

• **Temco Aircraft Corp.** reported higher sales but slimmer profit margins for the first quarter as the company moved to decentralize and prepare for expansion into new markets.

Temco President Robert McCulloch told the annual stockholders meeting that the company is in a period of transition from complete dependence on airframe subcontracting to emphasis on such areas as electronics and missile work, and that current sales and profits are symptoms of this transition. He said sales this year may dip as much as 8% below the 1958 level.

Sales in the first quarter were $28,142,563, a slight increase from the $27,157,059 figure for the same period last year. Profits were $589,642 last year and $467,156 this year in the first quarter. Backlog on Mar. 31, 1959, was $85.6 million, and McCulloch said Temco is currently entered in competitions with a total dollar value of more than $500 million.

Decentralizing to provide for a shift to new markets, Temco has split its operations up among three new divisions. An Electronics Division has been established under A. R. Teasdale for development and manufacture of systems and components produced by the company's growing electronics capability. A Missiles and Aircraft Division, headed by R. E. Galer, will handle such programs as the Corvus missile system and the TT-1 trainer, as well as subcontracting work. The new Aircraft Overhaul and Modification Division, led by E. Fred Buehring, covers overhaul and modification work on such aircraft as the C-97, KC-97 and C-121G.

Navy Satellite Group

Washington—Navy has formed two committees to study naval implications of earth satellites. One group, composed of civilian scientists, serves under the Operations Analysis Division of the Office of Naval Research. The other, composed of Navy officers, functions under the Chief of Naval Operation's office.

Latter group last week was briefed on projected programs by representatives of 14 industry groups. The Office of Naval Research group is scheduled to brief the officer's committee this week on scientists's ideas of the potential of earth satellites for the Navy.

Nuclear Ramjet Budget Boosted

Washington—Contract extension in March by Air Research and Development Command's Wright Air Development Center has boosted budget levels for nuclear ramjet development on Project Pluto at Marquardt Aircraft Co. Marquardt's staff on the joint Air Force-Atomic Energy Commission project has increased from about 40 in January to the present level of about 110.

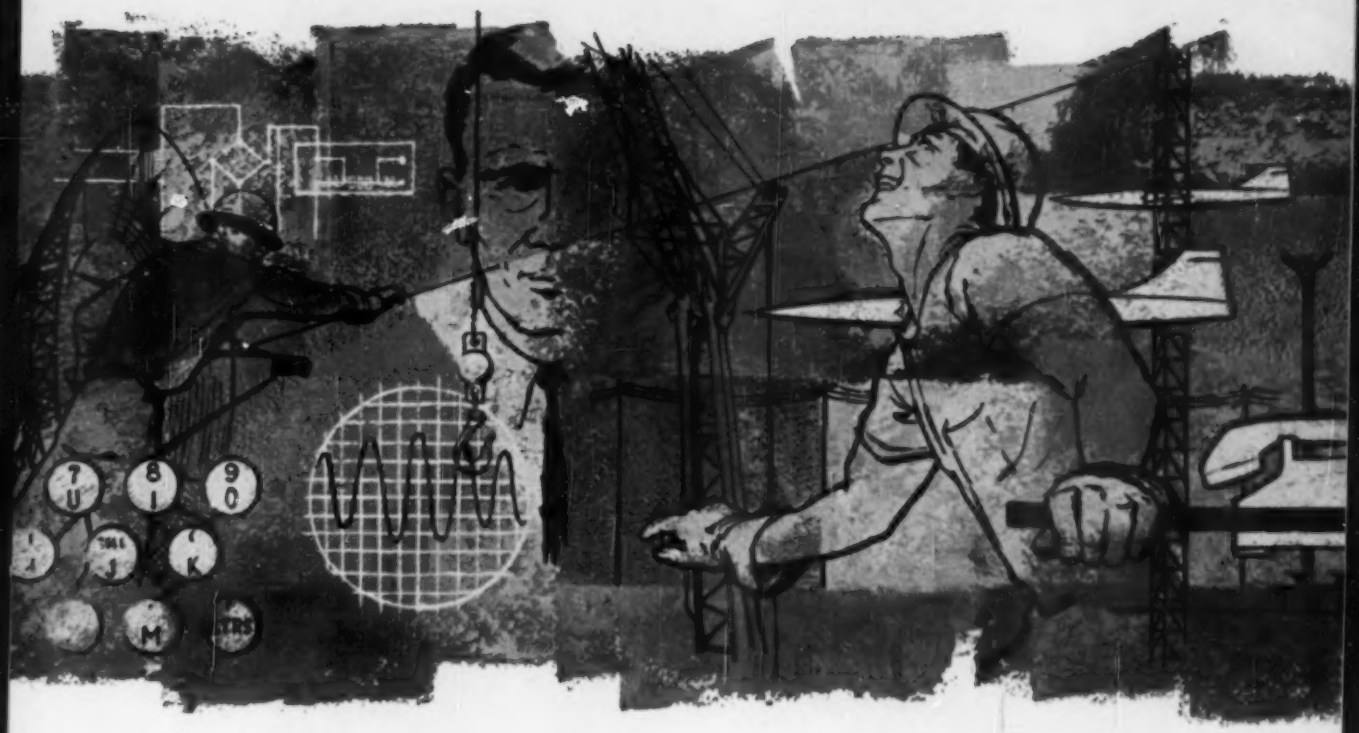
About half of the company's Pluto effort is in support of feasibility tests on non-flyable reactors, scheduled to be conducted by University of California's Lawrence Radiation Laboratory for AEC in Nevada Test Site's Jackass Flats area. In the test program for the initial test reactor, known as Tory II, Marquardt is designing and fabricating major portions of the reactor control system, the air ducts, flow instrumentation and remotely operated disconnects. It will also build and test structural components of the reactor core, will supply architect-engineering services on the test air supply system, and participate in a supporting program of environmental tests.

The remainder of Marquardt's effort on Pluto is concerned with design and development of its MA50 nuclear ramjet, for which the company also is designing the reactor, based on the principles of the non-flyable Tory II reactor. Major effort is on airborne reactor controls to meet severe environmental specifications, particularly temperature and radiation. As part of this program, the company has conducted in-pile tests of control components at Convair's Ft. Worth reactor facility.

Marquardt also has collaborated with industry members on studies (AW April 6, p. 37) of possible applications embodying the MA50 nuclear ramjet. Considerable Marquardt effort has gone into preliminary design of test facilities for full-scale powerplant development.

North American Aviation's Atomics International Division is performing materials research in support of the Lawrence Radiation Laboratory program.

ALPHA



A NEW NAME IN WORLD-WIDE SYSTEMS PROJECTS

To broaden and extend its systems projects services in keeping with the space age . . . Collins Radio Company has created Alpha Corporation . . . a wholly-owned subsidiary to be staffed initially with Collins specialists and executives.

For a number of years, Collins has been engaged in a concentrated program of design, engineering and installation of complex communication systems for both military and commercial uses. This program has resulted in the development of technical skills, management techniques and know-how representing a significant addition to the company's primary activity of developing and manufacturing individual units of electronic equipment. Alpha has been formed to expand upon Collins activities in this field.

Alpha, with its highly specialized systems management organization of designers, engineers, scientists and constructors, will produce complete, packaged commercial and government installations in this country and abroad . . . using the best available equipment from industry to deliver to its clients turn-key installations meeting the highest standards of dependability and quality . . . ready for operation.

Alpha will provide "on-the-job training" for customer engineers and technicians assigned to the installations . . . or furnish complete crews of skilled specialists to staff the finished projects.

Alpha CORPORATION

A COLLINS RADIO SUBSIDIARY

DESIGNERS, ENGINEERS, CONSTRUCTORS, WORLD-WIDE • RICHARDSON, TEXAS • TELEPHONE DALLAS ADams 5-2323 • CABLE ADDRESS: ALPHA DALLAS

Alpha capabilities include technical systems management in all fields, with special emphasis on: • Space vehicle tracking and communication • Test range instrumentation and communications • Voice, teletype and data transmission • Aircraft modification and overhaul • Integrated shipborne, airborne, and ground communications • High capability remote control and switching

Getting the most from Mach 2 power

USAF's Convair B-58 "Hustler," powered by four General Electric J79 turbojets, flies higher and more than twice as fast as any earlier U. S. jet bomber. Here's how skilled technical support by General Electric personnel is helping to speed this new air weapon through its testing program.

Objective: *complete* technical support for the B-58's four Mach 2 J79 jet engines! In Texas, where the airframe was designed and manufactured, and at every B-58 test site, highly trained G-E specialists are on hand full time to assist Air Force and Convair personnel on J79 installation, maintenance, and testing.

Backing them up is a four-point J79 ground support program, designed to keep the B-58 and other G.E.-powered Mach 2 aircraft *ready to fly* whenever they are needed:

- A J79 spare parts program, with G.E.'s unique depot concept providing direct shipment of parts from factory to user.
- Retrofit and modification programs to increase engine service life and performance, reduce operating costs.
- Specialized tools, equipment, and training aids for fast, efficient J79 maintenance and overhaul.
- Comprehensive technical manuals and parts-application publications to simplify J79 maintenance and parts identification.

When the B-58 reaches operational status with Strategic Air Command, support activity like this will become even more vital. General Electric's goal: to help keep the reliability of U. S. air power second to none. General Electric Co., Cincinnati 15, Ohio.

235-33

Progress Is Our Most Important Product

GENERAL ELECTRIC

NASA Awards Delta Contract to Douglas

Washington—Contract for $24,067,500 for 12 Delta satellite and space vehicles was awarded to Douglas Aircraft Co., Inc., last week by National Aeronautics and Space Administration. Delta will be used as an interim space vehicle in 1960 and 1961.

Delta is a three-stage Thor-Able of the type used last year by Air Force as lunar probes, but with a Bell Telephone Laboratories radio inertial guidance system and coasting guidance control added. Two-stage version of Thor-Able, equipped with the Bell Telephone guidance, has been fired five times over the Atlantic Missile Range as a nose cone and guidance test vehicle. Two of the five shots have been considered successful and three partially successful.

Missions planned for Delta include launching of equatorial and polar satellites and deep space probes. NASA also has told Congress that Delta could deliver a 100 lb. payload for a lunar impact; 65 lb. payload for an orbit around the moon; and 50 lb. for a rough lunar landing (AW April 13, p. 28). Delta is expected to cost about $2.5 million per vehicle after development (AW April 13, p. 129).

Delta is expected to be able to put 250 lb. in a 300-mi. earth orbit or send a 100 lb. payload deep into space. Stages are the Douglas Thor, powered by a Rocketdyne liquid propellant engine; an Aerojet-General Corp. Vanguard engine with guidance incorporated in this stage; Allegany Ballistics Laboratory solid propellant stage, also developed in the Vanguard program; and payload. Guidance will allow more precise control during the early part of the flight and active guidance control of longer coasting periods between second-stage burnout and third-stage ignition. Added coasting time results in maximum velocity being obtained at higher altitudes.

NASA Names Center After R. H. Goddard

Washington—New space research and development center for National Aeronautics and Space Administration will be named the Goddard Space Flight Center in memory of U. S. rocket pioneer Robert H. Goddard.

The center will consist initially of space projects building and a research projects laboratory to be located on a 55-acre tract acquired from the government's Beltsville Agricultural Center, northeast of Washington. Post Office address will be Greenbelt, Md. Completion of the buildings is scheduled sometime in mid-1960. Missions will include basic research and development. Eventually the center will become a command control center for space flight operations.

Abe Silverstein, NASA's director of space flight development, will give overall guidance to the center from NASA headquarters. Center director has not yet been named. The center will house three major research and development groups, headed by assistant directors; and departments of business administration and technical services.

Assistant directors are John W. Townsend, Jr., for space science and satellite applications; John T. Mengel, for tracking and data systems; Robert R. Gilruth, for manned satellites. Michael J. Vaccaro will be business manager.

In another move, NASA has named John P. Hagen, former chief of its Vanguard Division, as assistant NASA director for program coordination, and has integrated the Vanguard group into other major space flight projects.

Executives Promoted In Three Companies

New York—Promotions of top executives in three widely diversified companies were announced last week.

At General Dynamics Corp., Frank Pace, Jr., was elected chairman of the board and chief executive officer, with Earl D. Johnson, vice president, moving into Pace's post as president.

William B. Bergen, executive vice president of The Martin Co. was elected president, directing the functions of seven operating divisions. George M. Bunker, board chairman and chief executive officer, remains in that post.

General Precision Equipment Corp. directors elected James W. Murray, president of General Precision Laboratory, Inc., as board chairman, and D. W. Smith, president of Kearfott Co., Inc., as president. Murray succeeds H. G. Place, who was elected founder chairman, and Smith takes over from E. A. Link, former president, who retired from that office. Link, however, will continue as director of avionics programs and will remain on the board.

Other General Dynamics appointments include:

- **Carleton Shugg**, president of the Electric Boat Division. A senior vice president, he was the division's general manager at Groton, Conn.
- **Dr. Frederic E. Hoffmann**, president of the General Atomic Division, from his post as the division's general manager. He also becomes a senior vice president.
- **C. Rhoades MacBride**, senior vice president-operations. He formerly was vice president-operations.

Discoverer Passengers

Boston—Four white mice in a return capsule will be launched with Discoverer III into a polar orbit in about a month, Rep. Overton Brooks (D.-La.), chairman of the House Committee on Science and Astronautics, disclosed here last week at the American Rocket Society conference on controllable satellites.

The 2-ft.-long, 35-lb. capsule housing the four mice will be ejected over the Pacific Ocean. Recovery will be attempted by aircraft equipped with air-snatch probes. Existence of a new (third) radiation belt consisting of very "soft" nonhazardous protons surrounding the earth at an altitude of 20,000 to 30,000 mi. was predicted by Dr. Fred Singer, of the University of Marlyand.

News Digest

Army Ballistic Laboratory at Aberdeen Proving Ground, Md., is developing a solid propellant that Army says will be 10 to 15% more efficient than existing fuels. Ingredients are nitro cellulose, nitroglycerine, polyurethane, ammonium perchlorate, aluminum, magnesium oxide and two-nitro diphenlyamine.

Decca Navigator Co., Ltd. has issued a statement calling the February special meeting of International Civil Aviation Organization in Montreal a "complete farce." Company charges that the meeting did not decide the issue of VOR/DMET vs. Decca on technical grounds.

Lockheed Aircraft Corp. will build a supported monorail system for the Seattle Century 21 Exposition Corp. under $5 million contract.

Eastern Airlines last week gained Federal Aviation Administration authorization to raise the overhaul time on its Allison 501D engine in its Lockheed Electras to 1,000 hr.

Hughes Aircraft Co. will soon obtain two Convair B-58 Hustler jet bombers as testbeds for the fire control system of North American's F-108 long range Mach 3 interceptor. In addition, International Business Machine Corp. will receive a B-58 for use in development of its bomb-navigation system for the North American B-70.

Aeronca Manufacturing Corp. will produce the Pogo-Hi II E3C target missile system for White Sands Missile Range, N. M., under a $328,000 Army Ordnance Missile Command contract.

GENERAL ELECTRIC

U.S. Airlines Accumulate Jet Experience

Turbojet transports require precise handling in air and on ground; ingestion so far is no great problem.

By Glenn Garrison

New York—Teething troubles of the first U.S. jet services have been mostly of a minor nature, and so far the jets are fitting fairly smoothly into the pattern of airline operations.

The U.S. jet age began six months ago at New York International Airport when Pan American World Airways inaugurated service to Paris with its Boeing 707-120 jet transports. Now five airlines operate a total of 22 jet schedules a day in and out of Idlewild, and the volume will increase this summer.

Load factors have been extremely high and preliminary cost figures are promising. The big question is how greatly some of the problems will be magnified when jet traffic volumes increase and what the competitive buildup will do to loads.

Based on the initial experience:

• **The jet is a "handle with care"** airplane, requiring precise pilot techniques on the ground and in the air. Pilots are taking longer than had been expected to check out in the 707-120.

• **Engine ingestion** of foreign material, a major worry before the start of services, has so far proved much less of a problem than had been expected. One engine removal was first attributed to this cause, but that finding was later reversed (AW Dec. 22, p. 37).

• **Air traffic control** has not proved a serious problem for jets at terminals, but military blocking of en route air space and traffic control altitude changes have caused delays.

• **Contrary to previous** planning, the 707-120 with Pratt & Whitney JT3 engines will be operated transcontinentally at high speed rather than reduced power cruise. Recent studies indicate that, competitive speed racing aside, it may prove more economical.

• **Turbojet powerplants** have given very little trouble, less than those of their piston predecessors. Most bugs have been confined to aircraft systems and accessories such as the water injection pump.

• **Community reaction** from the noise of jets has not been bad, but anti-noise operating procedures at Idlewild are most unpopular with the airlines.

• **Safe and efficient operation** of jets may require new airport and navigation aids, such as runway barrier fences and improved approach instrumentation. Ramp handling of jets has been fairly satisfactory, although engine blast proved to be more of a problem than anticipated and has caused a change in Idlewild ground procedures. Ticketing and loading and unloading the bigger passenger volumes have not created serious problems so far.

• **Jet schedules** have encountered many delays, but few cancellations.

Idlewild, the present hub of jet operations, is undergoing changes which will make life easier for jet operators by the time the volumes grow. Four U.S. carriers—American Airlines, Eastern Air Lines, Pan American and United Air Lines, will complete construction this year of their multi-million-dollar individual passenger terminals in the airport's $150 million "terminal city" development.

Trans World Airlines and Northwest Orient Airlines will follow suit later. As these terminals are completed, the airlines can move their jet operations away from the inadequate, temporary terminal now in use, and can set up their own ramp handling procedures.

Engine blast emerged as a major problem during the early period of operation from the old terminal. In several instances, heavy equipment such as passenger stairs was blown across the ramp by blast and the Port of New York Authority, operator of the airport, ruled that blast fences must be installed at the jet gates.

These concrete fences proved unsatisfactory and the Port Authority added a requirement that turbojet transports be towed away from the gates before taxi power was applied. This ended at least temporarily the experiment with taxiing in and out from the gates, and the tow out adds time and trouble.

The Port Authority in other ways has found turbojet transports, from an airport operator's standpoint, less of a problem than had been feared. For example, deterioration of pavement from jet heat and fuel spill has not materialized to date. There have been no passenger complaints regarding noise at the ramp. Taxiway and jet runway sweeping has been handled satisfactorily, first by airport personnel cruising in a tractor and watching out for foreign objects, and since January using a Consolidated Diesel Electric Corp. motorized vacuum sweeper.

Ninety per cent of the Idlewild sweepings have consisted of clamshells dropped by seagulls. Because of this, Pratt & Whitney is now running tests to determine what effect clamshells have on its engines.

Runway 25 at Idlewild, the top priority jet runway because it takes the aircraft out over water, is being resurfaced at present. Roughness of this runway caused problems with high-speed jet takeoffs.

Here is a report on the experience of each airline operating jets at U.S. airports, in the order of their entry:

• **British Overseas Airways Corp.** has achieved an average passenger load factor of 80-90% on its de Havilland Comet 4 jets from the beginning of transatlantic service Oct. 4. It now operates a daily round trip from New York and a weekly flight from Montreal. BOAC says engineering delays amount to less than 20% of time lost in schedule delays, with weather being the principal factor in delays. About 30% of 309 Comet flights arrived on time, 71% arrived on time or within an hour of

National's Jet Costs

National Airlines' net operating revenue for its leased Boeing 707-120 jet operation from Dec. 10 through January was $672,955, according to the airline's figures. Total operating revenue for the period was $1,642,473 and expenses were $969,518.

Flying operations for the jet cost 254.87 cents per revenue mile by National's figures, which include the cost of leasing the equipment from Pan American.

National figures its breakeven passenger load factor for the period at 57.47%. Total revenue breakeven load factor was 48.73%. Revenue miles flown were 212,850; revenue passenger miles 20.777; available miles 23,431; load factor 88.67; yield 7.20 cents.

Cost of training, not reflected in the above figures, was put at $304,534.

schedule, and 95% on time or within six hours.

• **Pan American** has carried almost 65,000 passengers since inagurating the first U.S. airline jet service with the U.S. commercial jet airplane last Oct. 26. Load factor has averaged 91%. Pan American of course, encountered the drawbacks as well as the rewards of being first with the new airplane. It has had three incidents resulting in planes being out of service for major mechanical work: a dive to 6,000 ft. on a scheduled transatlantic flight, cause of which has not been officially determined; separation of an engine pod during a training maneuver over France, and a takeoff undershoot on a check flight involving loss of a landing gear and engine pod damage. Pan American has found the 707-120 engine a good one, especially compared with the powerplant of its latest-model piston plane. The J57, however, has not been trouble free by any means in Pan American's experience. Problems have included third-stage turbine wheel bearing troubles, erosion of seal rings, some trouble with turbines and guide vanes. On the other hand, expected trouble with hot section components such as burner cans and nozzles has not materialized. The three worst bugs in the aircraft systems, from Pan American's standpoint, have been the entire water injection system, the fuel gages, and the autopilot. There have been others, including freezing and cracking of airplane water system parts.

Blade Damage

There has been occasional blade damage from ingestion but of such minor nature that the blades were removed only at inspection intervals. Operationally, the Port of New York Authority restrictions probably have hurt Pan American more than any other carrier. Runway 25, first priority jet runway, was 8,200 ft. when PanAm began service, greatly reducing eastbound nonstop potential. The New York-London record for last November was 25% nonstop. Runway 25 was lengthened to 10,000 ft., and the December record went to 68%. January was 100%, February 100%, and March, 92%. On the Paris run, nonstop performance was hampered by big mail and cargo loads. The record to Paris: November, 7%; December, 29%; January, 81%; February, 71%; March, 74%. With hot weather this summer, depending on payload policy, Paris nonstops could drop to 40-50% and London nonstops to 80%.

• **National Airlines** has averaged 92% in load factor on almost 600 scheduled flights since Dec. 10 with leased PanAm 707-120s. This compares, the airline says, with a 50-60% load factor on its piston equipment over the same New York-Miami route. Passengers carried on the jets have totaled about 54,500. Operating cost studies show the 707-120 to be 7 to 10% less expensive to operate than the Douglas DC-7B, according to National. The airline has suffered numerous delays, usually caused by receiving its jets late from Pan American, it says. Traffic delays at takeoff also have been a factor. The only schedule cancellations have been because of weather. There have been three flight diversions, two from weather and one because of a malfunctioning fuel control. Pilot transition has run from 17 to 37 hr., higher than expected. All in all, training five crews cost National $304,500. National is little affected by the Idlewild noise rules, since the 707-120s takeoff gross for the run is only 205,000 lb.

• **American Airlines** flew its 50,000th jet passenger last week, achieving an average load factor over 95% to date since its first jet flight Jan. 25. Its Boeing 707-120s now fly New York-Los Angeles, Chicago-Los Angeles, and New York-Chicago-San Francisco, a total of five round trips daily. Introduction of jets has been different from introduction of past equipment in that "the big things have been done so well, it's the little things that have been our problems," according to Marvin Whitlock, vice president-operations planning. For example, American's experience with its jet engines has been almost trouble-free, whereas one of the biggest headaches and cause of delays has been fuel gage trouble caused by a wiring difficulty. Parts have been a problem, partly because the airline provisioned "rather thin" to start with. This has exaggerated delays that would have been only 30-40 min. to seven to eight hours while parts were flown from one station to another.

At the worst point as far as delays are concerned, about half of American's jet flights were suffering delays from all causes. The rate is now running about one or two delays a day, mostly because of the fuel gage problem, which is still being studied.

American expects to start pulling its first engines for overhaul in a few weeks. Time is now 800, expected to reach 1,000 hr. around fall. Whitlock told AVIATION WEEK that runway barriers will be "mandatory," not so much for overshot landings as for aborted takeoffs. He also would like to see development of radio altimetry, not so much for en route information as for approach use. Airports handling jets also need back course ILS, and/or at least the altitude portion of Precision Approach Radar, in Whitlock's view. American now makes no back course approaches at Idlewild, and circles to use the instrumented end. One fact American has learned from its experience is that a jet can't be comfortably taken off from a slushy runway. American also has found a need for much more airplane time for pilot training than had been anticipated.

• **TWA** came into the jet picture Mar. 20 with daily New York-San Francisco service, now also flies its 707-120s on daily round trips between New York and Los Angeles and one between Chicago and Los Angeles. Last week the airline completed 29 million jet passenger miles with load factors averaging over 96%. It has completed 98.8% of scheduled mileage. There have been only two delays over 10 min. for mechanical reasons, one a water pump and the other a main gear snubber. Air traffic delays have been minor. TWA operated its service from inauguration until April 9 with one line airplane, meeting all schedules. Payload has not been restricted by Idlewild rules but may when summer weather arrives. The airline has experienced one premature engine removal. The engine had been removed for third stage turbine inspection when metal chips were found in the oil. Pratt & Whitney overhauled the engine under warranty. This was not an ingestion incident, and TWA also is optimistic about the ingestion situation. There have been two diversions, both due to weather. Pilot training has taken longer than expected: the target of 12 hr. now stands at 20 hr. Few maintenance problems have been encountered, "nothing more than ordinary." These have been mostly in systems: water pump failures and integrated flight system troubles are examples. TWA expected its sixth jet last week.

PanAm Jet Costs

New York—Preliminary Pan American cost figures for its Boeing 707-120 jet operations are close to anticipated results. Costs of flying operations, direct maintenance and depreciation (including certain main component parts) are reported at 202.5 cents per total mile. Breakdown is flying operations, 106.3 cents; direct maintenance, 43.5 cents; depreciation, 52.7 cents. These figures include a number of accruals for as yet unfirm elements, and may be adjusted in later quarterly figures.

By the flight hour, PanAm figures its direct maintenance 707-120 costs at about $214. This compares with approximate figures for the Douglas DC-4 of $30; the DC-6 at $40; the DC-7 at $70; and the Boeing Stratocruiser at $100. The preliminary 707-120 figure includes allowances for learning curves and debugging. The airline estimates it may be able to bring the $214 figure down below $200 within the next year, partly because it will soon be doing its own engine overhaul.

Piston Fleet Phaseout Will Cut Capacity

New York—A sharp dip in the curve of transatlantic airline capacity is in prospect for this year as most carriers, their last piston fleet units already in service, wait to enter the jet competition on the route.

The total of scheduled seats available on the North Atlantic, which rose a record 33% in 1958 over the previous year, probably will go up only about 10% in 1959, an AVIATION WEEK survey shows. At the same time low-fare charter traffic, up 95% last year over 1957, is likely to increase again. By increasing their efforts in the charter market and holding down their scheduled offerings, many carriers are making sure their piston aircraft seats are filled even if they bring in less revenue at the lower rates.

During what is an interim year on the transatlantic run for most carriers, scheduled traffic is expected to increase about 18% over last year's total of 1,193,000 passengers. During the first three months of 1959, this traffic was up 19% to 189,600 passengers. Seats available total was up 14% to 341,300 seats.

By way of comparison, the first quarter 1958 seats available total was up 23% from first quarter 1957 and traffic was up 5%.

With the introduction of the economy fare last April, most transatlantic carriers geared their summer peak schedules for a vast expansion of business. This year's traffic increase of 23% over 1957 met their expectations to some degree, but they had achieved the same percentage increase in 1957 with only 18% more seats instead of 33%. There were 732,000 empty seats during 1958; only 428,000 the year before.

Traffic Pattern

While there are some important exceptions, the pattern appears to be to hold the line this summer in seat offerings or even in some cases to cut back. Examples:

• **Pan American World Airways,** although it is one of the only two jet operators this year on the Atlantic and is well out in front in jet capacity, will offer fewer peak season seats this year than in 1958. Pan American scheduled 84 flights in each direction last year during a peak week in June; this year's comparable offering will be 50 flights, a frequency reduction of 34. However, half the 1959 peak flights will be Boeing 707-120 jet schedules which will account for some 75% of the total capacity. Not allowing for extra sections, the June peak weekly seats may total about 500 less in each direction this year than last. For the entire peak season June through September, Pan American plans this year to schedule 81,762 seats in each direction, of which 56,838 will be economy class and 24,924 will be first and de luxe. The airline estimates its 1959 traffic increase at 8-10% in the first class category and 15-20% in economy business.

• **Trans World Airlines** will offer about 41% fewer scheduled seats during an average peak week this year, or a total of 5,550 in both directions. The split will be 920 first class, 4,430 economy. But TWA also will be carrying 90,900 Military Air Transport Service charter passengers across the Atlantic this year under a contract which also involved 23,964 MATS passengers during the last quarter of 1958.

• **Scandinavian Airlines System** will schedule three fewer flights out of New York during this peak season, and expects a capacity reduction of 5-8%. Its West Coast-Europe polar route schedules will remain the same, with slightly heavier emphasis on economy class. The New York-Europe seats will split 82% economy, 18% first.

• **KLM Royal Dutch Airlines** will raise its transatlantic scheduled capacity between the U. S. and Europe 8.4% this season. The carrier's scheduled capacity for the whole of 1958 was about 37% greater than in 1957. The 1959 peak weekly total will be 2,589 seats, split economy 2,185, first and de luxe 404. KLM predicts a 1959 traffic increase of 20%.

BOAC's Plans

On the other side of the 1959 coin, British Overseas Airways Corp., the other jet airline this year, plans to offer 32% more peak seats on the Atlantic. Of the 3,301-seat eastbound peak week total this year, 11% will be offered in BOAC's de Havilland Comet 4 jets. Forty-three eastbound flights will be scheduled, compared with 39 last year during a peak week. Bookings already on the list last month showed a 22.6% increase over the total at the same 1958 time.

BOAC also is operating its turboprop Bristol Britannias on the route again this year, in first-tourist-economy or de luxe-tourist-economy configurations. Its Douglas DC-7C piston flights will all be mixed tourist and economy. Comets will be used in all-first-class (including de luxe) configuration. BOAC says its transatlantic passenger traffic increased 54% in first quarter 1959 over first quarter 1958.

With BOAC geared to exploit its turbine aircraft to the full, the only other transatlantic carrier among the big six of traffic volume to increase its capacity greatly is Air France. The French carrier will boost its seats available by 18% for a peak week eastbound total of 2,106, of which 1,755 will be economy. However, last year's total capacity was 34% over 1957's.

Among the above six airlines, only SAS went the whole way and eliminated the tourist class when the economy fare came in last April. This summer, however, only BOAC among the six will offer tourist seats.

Other Carriers

Among the relatively smaller transatlantic carriers, Alitalia is an outstanding exception to the capacity trend with plans for an increase of about 73%. It predicts a 100% increase over the 26,429 passengers carried last year.

Sabena Belgian World Airlines offered 14,534 seats during an eight-week period in June and July last year; the comparable total will drop to 12,494 this year. Swissair's weekly total of 12 transatlantic round trips last summer will remain the same this year, but the airline expects a 20% increase in traffic.

The 33% increase in capacity last year was abetted by the introduction of new fleets of larger aircraft and by the economy class configurations. After the tourist class was introduced in May, 1952, total capacity that year went up 24% and the traffic jump was 31%. Another 25% capacity increase in 1953, however, brought a traffic rise of only 17%, as can be seen in the following table:

Year	Seats	% of Gain
1951	504,185	2%
1952	625,758	24%
1953	781,737	25%
1954	880,938	13%
1955	1,006,000	14%
1956	1,226,861	22%
1957	1,450,000	18%
1958	1,925,000	33%
Year	**Passengers**	**% of Gain**
1951	329,656	6%
1952	432,272	31%
1953	506,601	17%
1954	550,000	8%
1955	652,000	18%
1956	785,259	20%
1957	968,151	23%
1958	1,193,000	23%

In addition to the 1,193,000 scheduled passengers carried last year over the North Atlantic, almost another 100,000 passengers flew in chartered aircraft of the scheduled lines. This total was an

Over Atlantic

increase of some 95% over the year before, and came in the same year that the new and highly touted economy fare was available.

During 1959, according to AVIATION WEEK's survey, the scheduled airlines may increase their charter traffic to a total somewhere around 150,000 passengers. Among the examples that point up this trend:

- **Air France** flew 31 transatlantic charters last year, carrying 2,339 passengers. This year the airline expects to handle at least 52 charters.
- **Trans World Airlines** carried 20,911 charter passengers on the route last year in addition to the MATS traffic noted above. Because of the heavy MATS commitment, TWA's charter business will be somewhat less this year, but it is still expected to total some 18,000 passengers.
- **Pan American** carried 23,378 charter passengers last year, and expects a 1959 increase of up to 10%.
- **Lufthansa German Airlines** flew eight charters last year, expects about 25 this year.
- **SAS** carried 1,445 charter passengers in 1958, and expects more than double that volume this year. BOAC looks for a 150% increase. Swissair expects a 50% rise.

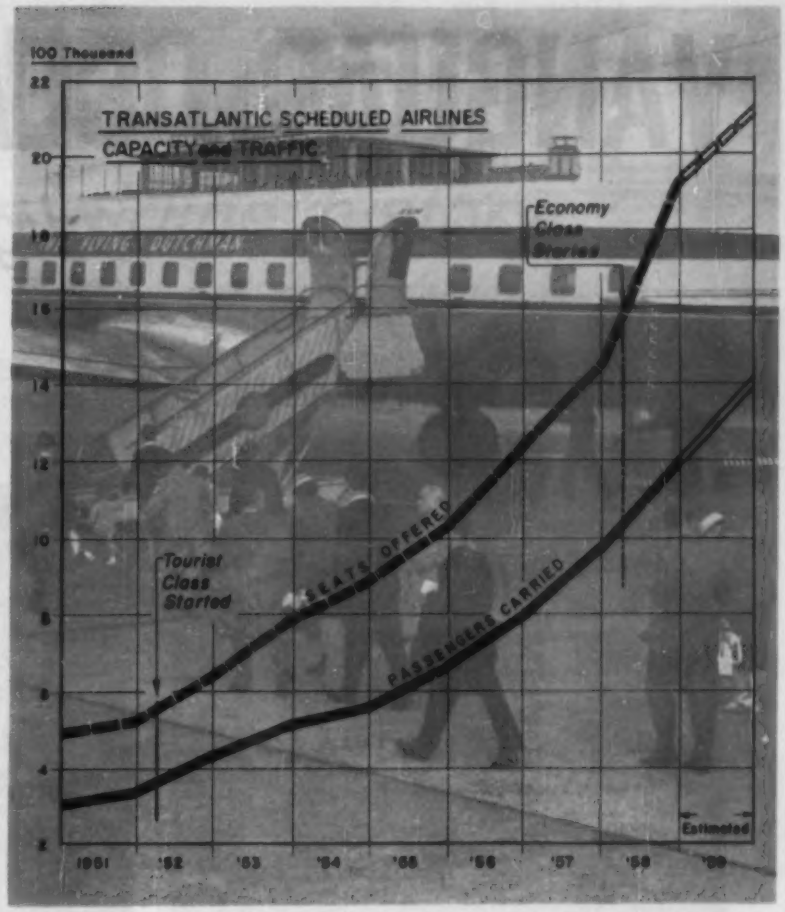
Not all of the carriers are happy to see the growth of charter business, at least during the on season. Some, like SAS, feel that the proper place to handle this growing market for really cheap transatlantic transportation is in the cabins of scheduled airliners at lower-than-economy-fare prices for special excursion flights.

Travel Agents Unhappy

Travel agents, who provide the great bulk of transatlantic scheduled airline customers, are unhappy with the restrictions imposed on them in charter transactions, among them being the prohibition against selling ground tour packages along with charter transportation.

Nevertheless, there is general agreement that charter rates are developing a market among people who wouldn't go at all if the price were even at the present economy-fare level. And the scheduled carriers are facing increasingly stiff competition from supplemental airlines flying charters on the route.

Last year, the AVIATION WEEK survey indicates, about 50,000 passengers were handled by these supplemental carriers. The total in 1959 may reach 70,000. Along with the scheduled airlines' charter passengers, this would mean a grand total of 220,000 charter-rate commercial passengers flying the Atlantic this year.



TOTAL number of scheduled seats available on the North Atlantic rose a record 33% in 1958 over the previous year but probably will increase only by about 10% this year.

The non-scheduled transatlantic operators this year are using a variety of equipment, including Lockheed 749 Constellations, Douglas DC-4 and DC-6 series aircraft, and Boeing Stratocruisers. The Stratocruisers, flown on the route last year by BOAC on its first class Monarch service, will be operated this summer by Transocean Air Lines. The supplemental carrier will use four Stratocruisers on the Atlantic with a maximum 100-passenger main cabin and 12 seats in the lower-deck lounge. Fare for an 80-passenger configuration will run about $285 per passenger round trip if all seats are sold; in the 100-passenger cabin, fare will be about $220. Transocean handled 31 round-trip commercial charters last year, expects to more than double that total this year.

Overseas National Airways, another of the bigger transatlantic charter operators, will operate four DC-6As in 80- or 97-passenger configurations. It handled about 60 commercial round trips last year, expects an increase in 1959. Among the charter deals Overseas National has sold is a plush flight for 60 passengers, who will charter at the 80-passenger rate and pay about $370 each for the round-trip transportation and $250 for the ground portion of the tour.

Flying Tiger Line

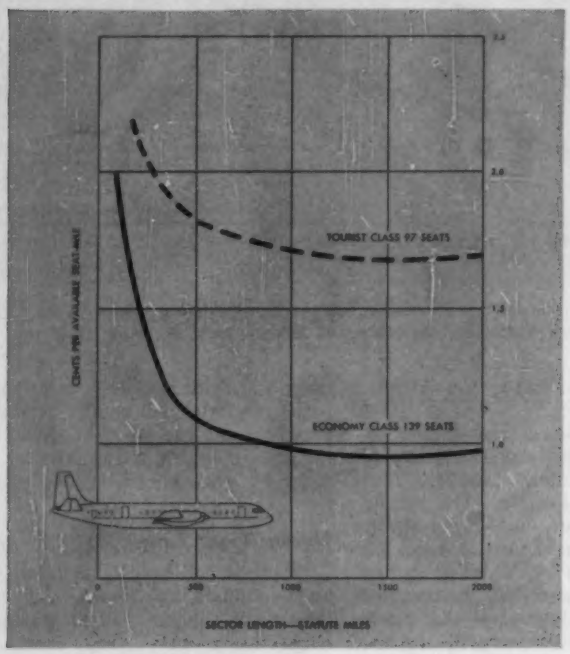
Flying Tiger Line, active last year in the transatlantic charter market to the extent of about 13,000 passengers, is practically out of the business this year. Among the reasons cited by Flying Tiger are the need for its Lockheed 1049H Constellation equipment on its domestic scheduled cargo services and military charter contracts, Flying Tiger also points out that back leg return flights on the Atlantic are harder to fill this year because more MATS business has shifted to an annual contract basis instead of a month-to-month bidding situation.

The travel agents feel they have problems not only with the rules under which charters are supposed to operate, but with how the rules are enforced. The American Society of Travel Agents told AVIATION WEEK it had received

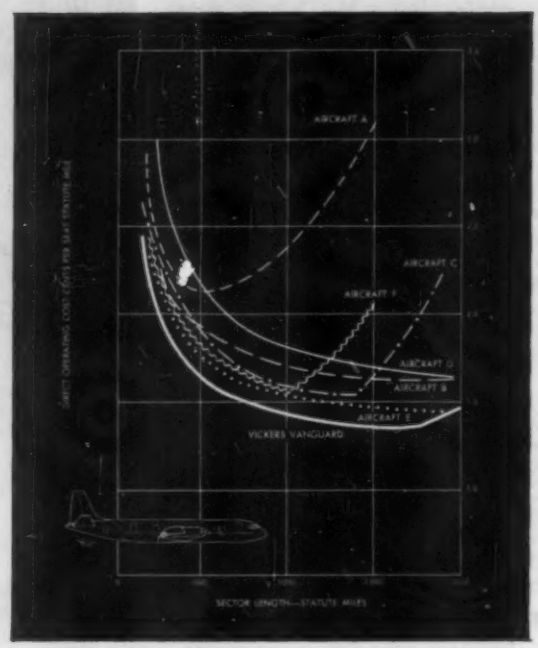
VANGUARD SEAT-MILE

Highest profit

On sectors of 900 to 2000 miles, the new jet-prop Vickers Vanguard offers seat-mile costs *under 1¢* on an economy-class configuration (139 seats). From 100 to 900 miles, costs are below 2¢ with the same configuration. The curves below, based on ATA formula costs, are representative for American carriers.



Airline study shows lowest operating costs – The following graph was prepared by one of the world's major airlines. It compares the Vanguard with five other modern airliners (all with economy configurations) and shows the Vanguard by far the most economical.



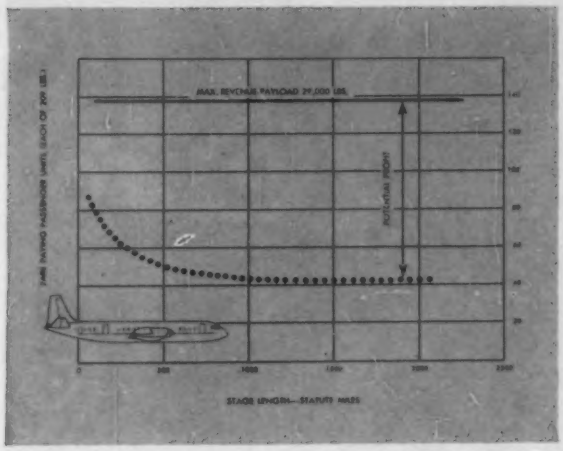
Low break-even means high profit—Because of its low operating costs and its large payload capacity, Vanguard profit potential is the best ever offered to the airline industry. On high-density routes, it will be *at least 35% higher* than that of any comparable aircraft.

The curve in the next graph plots only the passenger break-even load factor.

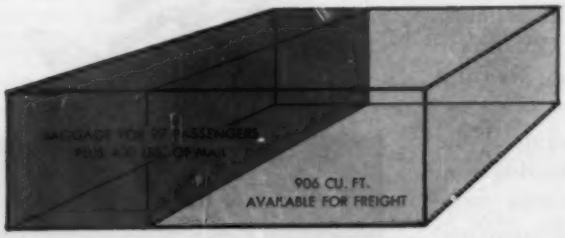
NEWEST FROM THE WORLD LEADER IN JET-PROP AIRCRAFT...

COSTS UNDER 1¢

potential in airline history



Large, well-balanced passenger/freight capacity — In addition to its large comfortable passenger capacity, the Vanguard offers a *further* bonus in *freight* capacity. After accommodating all baggage for 97 passengers and 400 pounds of mail, there is still 906 cubic feet available for revenue-earning freight. The Vanguard can be operated profitably during off-peak passenger periods, thus increasing utilization and profit potential.



On some routes, Vanguard is fast as jets—or faster!

STAGE LENGTH — STATUTE MILES	THEORETICAL PURE JET GAIN OVER VANGUARD
200	6 MINUTES
400	11 MINUTES
800	22 MINUTES
1000	46 MINUTES

The chart above shows the comparative block times of the 425-mph Vanguard and a 600-mph pure jet. It is well worth noting that the Vanguard offers all its economic advantages with only the slightest sacrifice in speed on all stages up to 800 miles. In fact, on stages up to 400 miles, the Vanguard will most likely be as fast — or faster — than a pure jet in high-density, day-by-day operations. This is because of the Vanguard's outstanding operational flexibility. It can operate on low-level routing and presents no problems in meeting ATC approach patterns and stacking requirements which, in high-traffic areas, could very well dissipate the marginal speed advantages of pure jets.

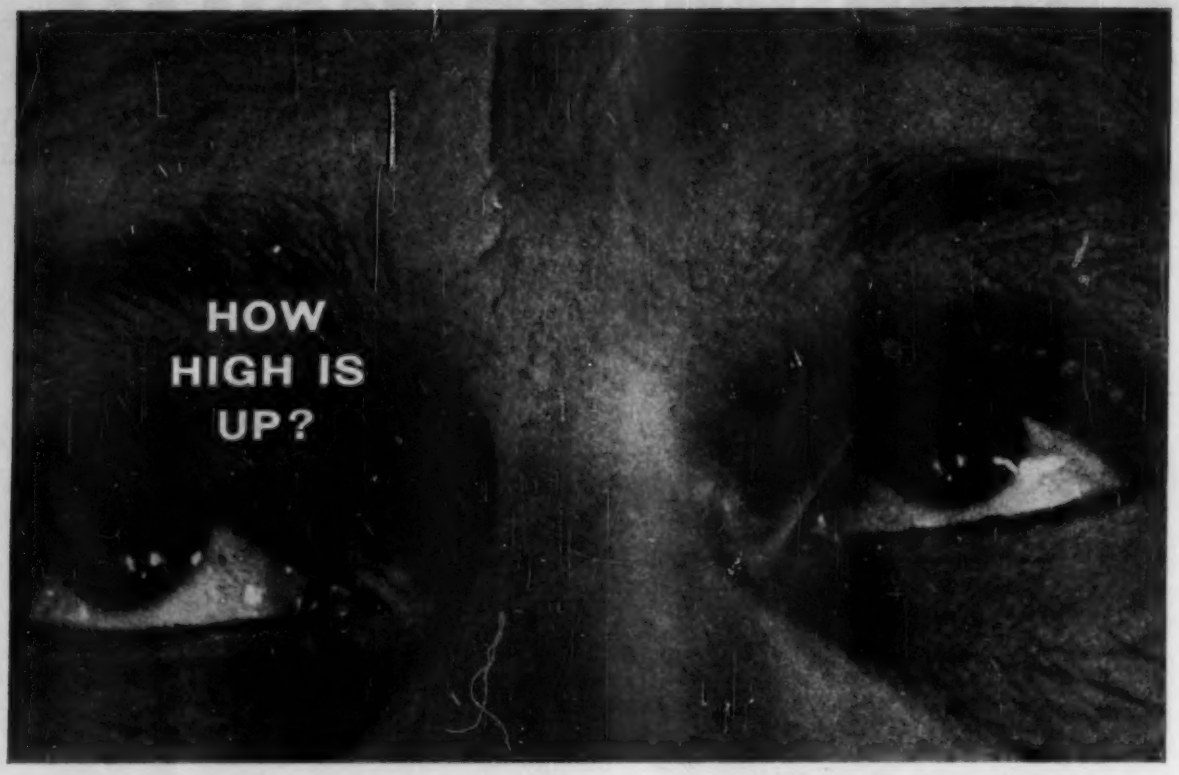
And jet speed is expensive. The slight advantage of pure jets on short and medium ranges is outweighed by the wide difference in operating costs: 1¢ per seat-mile at 200 miles, 0.75¢ at 600, 0.65¢ at 1000.

If you would like detailed Vanguard specifications and a complete cost analysis based on your operations, contact Christopher Clarkson, U.S. representative, 10 Rockefeller Plaza, New York 20, New York.

VICKERS VANGUARD

POWERED BY FOUR ROLLS-ROYCE TYNE ENGINES

VICKERS-ARMSTRONGS (AIRCRAFT) LTD. • WEYBRIDGE, ENGLAND • MEMBER COMPANY OF THE VICKERS GROUP



Quadradar provides rapid accurate altitude of all aircraft in terminal area!

Provides greater safety through rapid coverage of all runways from one location

Gilfillan Quadradar provides rapid, accurate altitude, azimuth and range information on any aircraft, up to 50,000 feet. Quadradar provides further safety with rapid coverage of all runways from one location.

With Quadradar, pilots are informed of other aircraft in the terminal area, reducing collision hazards. Aircraft are landed from either direction of runways without relocating equipment.

Quadradar provides terminal area surveillance, final approach, height-finding and airfield surface information. It is compatible with present systems to make for greater safety in final approach, air traffic control and high-performance climb-outs.

SEVEN GILFILLAN PLANTS IN SOUTHERN CALIFORNIA / HEADQUARTERS: 1815 VENICE BOULEVARD, LOS ANGELES, CALIFORNIA

GILFILLAN QUADRADAR IS NOW IN OPERATION BY THE U.S. ARMY, USAF, U.S. NAVY, U.S. MARINE CORPS, ROYAL CANADIAN AF, ROYAL DANISH AF, FRENCH AF, ARGENTINE NAVY, GERMAN AF, ITALIAN AF, FINNISH AF, YUGOSLAV AF, ISRAELI AF, IRISH CAA, ROYAL AUSTRALIAN AF, FRENCH CAA, AUSTRIAN CAA, BOEING AIRPLANE CO., AND NORTHWEST AIRLINES. LOCKHEED, DOUGLAS, CONVAIR, NORTH AMERICAN AND HUGHES AIRCRAFT COMPANIES HAVE A JOINT OPERATION USING QUADRADAR AT PALMDALE FLIGHT TEST CENTER. OTHER INSTALLATIONS INCLUDE MOFFETT NAS, AND AT THE SOUTH POLE.

about 100 complaints during the first quarter of 1959 from member agents across the country, mostly concerning alleged illegal solicitation of charter groups or supposed legal ineligibility of groups that were chartering airplanes.

ASTA would like to see scheduled fares competitive with charter rates. This, according to the agents' association, would prevent the traveling public from "resorting to subterfuge" in obtaining low-cost transportation.

Charters operate under Civil Aeronautics Board rules in the case of the supplemental carriers and International Air Transport Assn. rules in the case of the scheduled lines. But since CAB must approve or disapprove IATA resolutions, a disagreement over charter conditions has led to a peculiar situation this summer.

The international association adopted its yearly charter resolution last fall at Cannes, but it has yet to be approved by CAB although it was supposed to go into effect April 1. Meantime CAB has suggested certain revisions to bring the IATA rules closer to its own charter regulations, and has indicated that its approval would be subject to these changes. Among the conditions are rules governing travel agency participation, more precise definition of charter groups, and a definition of immediate family in connection with group eligibility.

Informal Rules

The odd situation now prevailing is that charter transactions are operating, as far as IATA is concerned, under no formal set of regulations. IATA is informally going along with CAB's requirements.

Travel agents particularly dislike a new condition prohibiting the agent who books charter transportation from also handling the land tour business of the same group. ASTA last month asked CAB to rescind this requirement and one denying commissions to an agent who is a member or has a member employe of the chartering organization. ASTA also questioned the Board's authority in "indirectly regulating the travel agent industry."

Confusion in the charter operation is further compounded by airline differences as to the proper relationship of charters to scheduled activity.

Some carriers go after them without reservations, while others have basic doubts as to their effect on scheduled business.

In any case, the increasingly important market represented by charter passengers cuts across several issues the carriers face, including the controversy over fare differentials for different types of equipment and the disposition of used piston and turboprop fleets.

Piedmont, West Coast Report F-27 Phase-In Costs Less Than Expected

By Robert H. Cook

Washington—Phase-in of Fairchild F-27 turboprop transports by local service carriers may be completed at less than projected costs, according to an analysis of 1958 Civil Aeronautics Board figures for Piedmont and West Coast Airlines.

Piedmont has reported an average F-27 load factor of 63.3% from November to the end of the year, as compared with a predicted 51.42% average by June 30 and a future 55.24% by 1961. Fourth quarter results for the carrier also show direct operating expenses, including flying operations, maintenance and depreciation of only 1.87 cents per seat mile as compared to an expected 2.1 cent prediction (AW Nov. 24, p. 39).

Deducting a depreciation rate of 54.4 cents per plane mile, Piedmont records show that F-27 direct costs reached a low of 1.52 cents per seat mile, based on average available seats of 30.3, as compared with 2.07 cents for the Douglas DC-3.

Break-even load factor, based on present subsidy levels, was announced earlier as 48.5%.

Under a detailed listing of direct expenses for the fourth quarter, Piedmont reported a cost of 31.54 cents per plane mile for F-27 flying operations; 23 cents for direct maintenance and 12.70 cents for depreciation. During the same period, these expenses for DC-3 operation amounted to 36.31 cents; 13.37 cents and 1.65 cents, respectively.

West Coast's Experience

Since West Coast began F-27 service last September, the carrier reported a 53.4% load factor on the turboprop by the end of 1958 with fourth quarter results showing direct operating expenses of 2.47 cents per plane mile, less depreciation, as compared to 2.69 cents for the DC-3. The airline's flying operations expense for the turboprops was listed as 52.67 cents per plane mile, along with direct maintenance costs of 36.10 cents and depreciation of 21.67 cents.

Comparative figures for West Coast's DC-3s were 48.15 cents, 16.52 and 3.92 cents.

Figures submitted to CAB by the carriers cover six F-27's operated by West Coast and eight by Piedmont. While the costs of West Coast are generally higher than those of Piedmont, both carriers look for future savings in engine maintenance with the expectation that the Federal Aviation Agency will lift the present overhaul ceiling of 700 hr. on the Rolls-Royce Dart 6 engines to meet the 2,000 hr. overhaul time now enjoyed by Viscount operators who utilize the same power plants.

Both airlines have also met with CAB to discuss changes in CAB Special Regulation 422a which restricts the F-27's gross takeoff weight to a point where loads have sometimes been restricted at stations where runway temperatures have reached 87F (AW Mar. 2, p. 30).

Direct Expenses

Direct aircraft operating expenses in dollars per hour for the F-27 were reported at $180.31, including depreciation, for Piedmont and $194.46 for West Coast, with flying operations of $84.57 per hour for Piedmont and $92.80 for West Coast. Direct maintenance cost per hour was listed at $61.69 for Piedmont and $63.50 for West Coast.

Total flying operations cost, based on 209,704 mi. flown during the period by Piedmont and 416,455 by West Coast, was $66,132 and $217,697, respectively. Total direct maintenance expenses of $48,244 were recorded by Piedmont, and $148,978 by West Coast.

During 1958 Piedmont achieved an average daily utilization rate of about 5 hr. for the F-27 for a fleet total of 782 hr. at an average flight speed of 202 mph. and a fuel consumption of 345.5 gph.

In comparison, West Coast's utilization rate on the turboprop was 4 hr., 33 min., for a fleet total of 2,346 hr. at an average speed of 177 mph. and a fuel consumption of 280.4 gph.

Since submitting its fourth quarter reports, Piedmont has reported increasing its F-27 daily utilization rate to six hours and West Coast to seven.

TWA Completes First Reorganization Phase

New York—Trans World Airlines has completed the first phase of its reorganization program (AW April 12, p. 36) with the creation of several new offices and the realignment of others. Chief objectives of the plan are to separate policy making and planning from day-to-day operation.

A new position of system general manager, with responsibility for all line

SOUTH ATLANTIC CONQUERED BY AIR
MERMOZ • DABRY • GIMIE ESTABLISH FIRST COMMERCIAL TRANS-ATLANTIC AIR SERVICE
SAO PAULO, BRAZIL, May 13, 1930 —The first trans-atlantic commercial flight became history this morning when Jean Mermoz and two companions landed at Natal at 6:12 after a flight of 20 hrs. and 16 minutes from St. Louis, in Senegal, Africa. The intrepid French fliers were eagerly awaited in Rio de Janeiro

FIRST IN INTERNATIONAL AIR TRAVEL! This year marks Air France's 40th Anniversary as the world's first international airline. During these 40 years, there have been many changes in equipment, routes and airline philosophy. But one thing remains constant. Air France still follows the great tradition of French leadership in aviation. That's why this year, when other airlines are making plans, Air France is making history with the fastest jets in Europe and the Middle East. Next year, Air France will cover the world's largest route network with one of the largest pure-jet fleets in the world.

AIR FRANCE

WORLD'S LARGEST AIRLINE/WORLD'S FIRST INTERNATIONAL AIR SERVICE

BEA Vanguard to Make First Overseas Flight May 6

British European Airways' Vickers Vanguard (left) is the first of 20 ordered by the airline. It will make its first overseas flight May 6 to Hamburg, Germany. First flight was April 22. Vickers' first production Vanguard (right) has flown 120 hr. since its initial flight Jan. 20, an average of 1 hr. 20 min. per day. The Rolls-Royce Tyne turboprops are rated at 5,500 chp. each.

operation, will temporarily be filled by TWA President Charles S. Thomas. Other innovations include creation of a department of planning and research, a department of equipment retirement to market piston aircraft, and a scheduling department.

New officers of the company are Floyd D. Hall, vice president-flight operations; E. Paul Burke, assistant vice president and executive assistant to the general manager; Henry D. Fellows, assistant vice president-schedule planning and market research; Alfred E. Jordan, assistant vice president-maintenance and engineering; John T. Logan, assistant vice president-scheduling; and Russell K. Rourke, assistant vice president-equipment planning and development.

Under the realignment of officers, Frank E. Busch becomes vice president of the department of equipment retirement; Raymond M. Dunn becomes vice president-technical services; Thomas K. Taylor becomes vice president-Washington with an interim assignment as special assistant to the president; and Robert W. Rummel becomes vice president-planning and research.

Electra Vibration Fix Proposed

Washington—Elimination of excessive vibration in Lockheed Electra (AW Feb. 23, p. 37) appears likely as a result of manufacturer's tests which last week indicated raising the engine angle of attack as a major fix.

Changing the engine thrust line from its former position of one degree nose down, below the fuselage reference line, to a tilt-up position of two degrees above, has reduced propeller inflow loads formerly transmitted back to the engine nose gear box, according to the latest Lockheed engineering studies. Attendant reduction of the airflow angle lowers vibration formerly encountered by the fuselage at the propeller plane and is expected to affect maintenance through better parts life expectancy.

In conjunction with the engine modifications, Lockheed also expects to modify the present propeller synchrophasing on the Electra by changing the angles of propeller blades to maintain the same level of power while lowering the noise level.

Although Lockheed says these are the major changes needed to solve the vibration program, the company is continuing its flight test work to determine the need for any further refinements. Actual flight test of the modified Electra is hoped to be completed in time for Lockheed to acquire an amended approved type certificate by the end of this month.

Company spokesmen estimate that Electras leaving the assembly line in mid-July will contain the modifications indicated by the vibration tests, and that a field program of modifying and retrofitting planes already delivered will be conducted simultaneously. Down time was estimated at five days per aircraft for the changes.

Lockheed also emphasized that the changes will not delay deliveries.

Whitlock Moves

Washington—Capital Airlines last week announced the appointment of Marvin Whitlock, former vice president of American Airlines, as senior vice president for engineering and maintenance. Whitlock is the third American Airlines officer to move to Capital in an executive capacity in the past year.

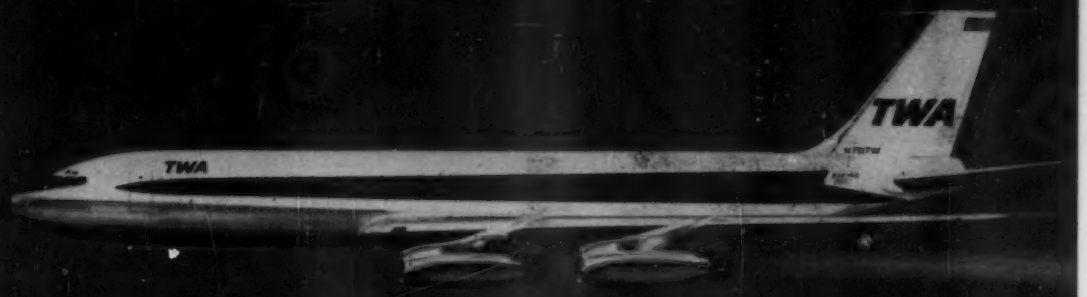
Earlier Retirement Urged for Pilots

Los Angeles—Age/efficiency factor may force a lower retirement age for airline pilots, according to Dr. John E. Smith, acting chief air surgeon for the Federal Aviation Agency.

At the Aero Medical Assn. conference here, Dr. Smith recommended mandatory retirement at age 60 and possibly earlier, if in the opinion of physicians, a pilot showed signs of performance deterioration. He estimated that there are presently 30 pilots over 60 now flying actively with the airlines and seriously questioned the ability of a man in this age bracket to cope with newer, high-performance aircraft.

Anticipating bitter opposition from the Air Line Pilots Assn. to any regulation which would force early retirement, Dr. Smith admitted that revoking a pilot's license, thereby depriving him of his livelihood, is a matter for serious concern. However, he said that FAA could not stand by and permit ALPA and the airlines to haggle over human lives at the bargaining table. Even though a man of age 60 may be of robust health, Dr. Smith added, his ability to cope with new aircraft and attendant changes in procedure may be impaired by decreased efficiency, resulting in a lowering of the age/efficiency factor. This age problem will increase since, he estimated, by 1970, 1,500 airline pilots will be age 60 or over.

Federal Aviation Agency also expects to adopt a "get tough" policy with private and other commercial pilots by increasing physical standards. Both medical examiners and corporations employing pilots have been apathetic regarding physical standards in the past, he said.



TWA Jets now serve:

NEW YORK
CHICAGO
LOS ANGELES
SAN FRANCISCO

THE WORLD'S FASTEST AND LARGEST JETLINER

TWA BOEING 707

See your travel agent or call TWA

TWA

TRANS WORLD AIRLINES

Airline Traffic—February, 1959

	Revenue Passengers	Revenue Passenger Miles (000)	Load Factor %	U. S. Mail	Express	Freight	Total Revenue Ton-Miles	% Revenue to Available Ton-Miles
DOMESTIC TRUNK								
American	513,492	353,662	63.6	1,631,388	737,535	7,120,370	43,529,393	56.4
Braniff	164,591	69,850	60.6	304,812	161,548	503,055	7,674,802	50.3
Capital	268,141	116,364	56.7	429,562	206,877	277,399	12,069,632	46.3
Continental	59,942	28,729	47.6	90,802	42,513	136,745	3,034,499	42.6
Delta	220,767	114,072	57.1	381,023	225,373	1,073,013	12,677,213	51.6
Eastern	586,627	344,678	53.17	906,130	422,785	1,112,894	35,721,912	49.46
National	153,243	106,694	62.2	314,821	66,889	572,809	11,342,633	49.5
Northeast	82,059	43,762	53.4	113,997	29,426	103,576	4,443,526	43.2
Northwest	116,768	88,453	48.2	495,045	213,803	1,103,452	10,319,761	42.5
Trans World	331,185	266,897	60.5	1,183,777	599,202	2,080,203	29,426,828	54.6
United	478,945	327,539	58.4	2,533,772	836,907	5,272,734	40,179,176	53.7
Western	108,452	56,954	58.0	244,999	74,987	268,627	6,052,990	49.2
INTERNATIONAL								
American	11,359	12,598	79.4	10,341	455	240,777	1,554,174	73.0
Braniff	3,450	6,455	47.7	15,301	.....	98,872	819,653	44.2
Caribbean-Atlantic	28,884	2,062	70.7	1,681	.....	4,502	225,387	77.8
Delta	3,635	4,151	44.3	6,748	.....	42,103	512,593	40.1
Eastern	30,431	44,606	54.99	95,941	.....	120,993	4,853,840	54.39
Mackey	9,822	1,992	41.0	.....	234	2,794	217,996	40.9
National	6,077	4,559	53.6	7,043	2,740	34,581	529,157	46.6
Northwest	9,240	20,296	45.4	1,354,253	22,070	798,441	4,359,861	63.7
Pan American								
Alaska	1,905	1,985	26.7	21,536	.....	107,935	345,889	37.6
Atlantic	61,208	85,059	59.0	1,194,866	.....	2,241,692	12,531,193	56.0
Latin America	100,919	102,083	69.0	345,107	.....	4,263,960	14,923,135	69.7
Pacific	22,013	85,059	73.5	1,235,063	.....	1,761,628	11,836,725	68.4
Panagra	10,798	15,228	64.5	62,424	.....	432,246	2,153,857	67.1
Resort	.....	.....	.....	.....	.....	4,064,290	4,064,290	79.7
Trans-Caribbean	6,423	10,258	67.3	.....	.....	119,187	951,142	66.2
Trans World	21,533	65,416	67.0	856,599	.....	1,803,231	9,430,139	67.7
UMCA	186	61	45.2	.....	.....	724	7,092	47.5
United	6,733	16,728	58.0	131,312	.....	76,665	1,921,631	57.0
Western	4,052	6,308	64.2	6,018	.....	14,615	689,338	66.1
LOCAL SERVICE								
Allegheny	30,752	5,257	42.2	10,256	18,986	17,610	548,621	42.7
Bonanza	15,777	3,743	52.1	5,389	1,899	7,122	372,963	50.1
Central	11,223	2,258	35.7	6,022	3,241	10,580	236,359	32.7
Frontier	17,720	4,281	42.2	17,684	7,008	49,174	485,493	50.3
Lake Central	13,989	2,217	39.2	3,335	11,943	.....	227,530	42.6
Mohawk	35,512	6,768	54.8	8,498	10,919	11,684	676,256	54.7
North Central	54,093	8,785	45.2	25,590	30,853	.....	900,538	46.3
Ozark	31,353	5,449	47.1	9,148	14,426	15,625	559,295	49.0
Pacific	29,008	6,467	48.8	10,820	3,978	8,257	639,742	47.0
Piedmont	30,422	6,251	40.2	13,223	10,454	10,453	633,031	40.6
Southern	16,454	2,901	35.2	8,629	9,549	8,802	305,303	35.4
Trans-Texas	18,002	4,118	41.1	13,827	7,227	22,994	438,369	41.9
West Coast	22,325	4,327	46.64	4,914	2,077	7,601	427,830	45.25
HAWAIIAN								
Aloha Airlines	12,538	1,717	55.5	650	.....	5,375	143,642	54.9
Hawaiian	29,022	4,368	58.94	4,209	.....	100,161	454,758	58.76
CARGO LINES								
AAXICO	.....	.....	.....	10,227	18,257	3,041,244	3,069,728	75.5
Aerovias Sud Americano	.....	.....	.....	.....	.....	459,930	459,930	87.0
Flying Tiger	1,207	5,814	100.0	32,941	42,485	8,479,020	9,135,900	86.0
Riddle								
Domestic	.....	.....	.....	6,432	24,099	3,498,153	3,528,684	74.8
Overseas	.....	.....	.....	.....	.....	654,245	654,245	69.5
Seaboard & Western	670	2,725	100.0	318,262	.....	3,279,194	3,880,834	65.3
Slick	2,760	17,577	92.03	.....	.....	.....	1,757,673	92.03
HELICOPTER LINES								
Chicago Helicopter	8,106	152	35.4	1,035	.....	.....	15,509	30.6
Los Angeles Airways	2,219	85	48.6	3,986	2,031	.....	14,139	54.6
New York Airways	6,296	124	36.9	1,307	1,242	559	14,972	39.3
ALASKA LINES								
Alaska Airlines	5,193	2,708	36.9	61,371	2,540	142,960	485,999	36.3
Alaska Coastal	2,586	242	56.3	3,927	.....	2,866	31,518	64.9
Cordova	739	96	37.5	3,321	.....	31,091	44,354	43.5
Ellis	3,036	185	55.9	1,623	.....	1,757	22,309	67.5
Northern Consolidated	1,190	400	40.7	23,072	.....	29,302	97,263	62.6
Pacific Northern	6,192	5,434	37.6	94,938	5,557	176,732	866,963	48.5
Reeve Aleutian	699	617	31.3	31,699	.....	80,961	181,436	53.8
Wien Alaska	2,174	540	14.4	32,024	.....	246,648	334,324	38.1

Compiled by Aviation Week from airline reports to the Civil Aeronautics Board.

This is *the* year to enjoy the richness of Europe through the magic of Pan Am Jet Clippers.

Over 50,000 transatlantic travelers have discovered the secret of Jet Clipper magic

Experienced travelers know what it means to be able to fly to Europe in nearly *half* the time with more than *twice* the comfort. This is the Jet Clippers' secret for making friends, and keeping them.

Today, 6 out of 7 transatlantic Jet travelers fly by Jet Clipper*. This overwhelming preference says more about the vibration-free comfort and amazing speed than could anything else. Today, the few hours to London, Paris and Rome pass like magic minutes.

It's no secret that the Jet Clippers offer the finest, fastest, most comfortable transatlantic jet service at the lowest jet fares. Typical that it should be done by Pan American.

*Trade-Mark, Reg. U.S. Pat. Off.

FIRST ON THE ATLANTIC... FIRST ON THE PACIFIC...
FIRST IN LATIN AMERICA... FIRST 'ROUND THE WORLD

PAN AM

WORLD'S MOST EXPERIENCED AIRLINE

The Boeing 707 Jet Clippers are the most thoroughly flight-tested aircraft ever to enter commercial service.

AIRLINE OBSERVER

▶ Look for renewed interest in a turboprop conversion of the Douglas DC-7. Napier Engines, Inc., officials have discussed several programs with Douglas which offer a wide range of conversion opportunities. Civil Aeronautics Board also is evidencing interest in conversion plans now in effect or under discussion.

▶ Pan American World Airways is revamping its entire spring transatlantic schedule because of a temporary restriction imposed on turbojet operations at the London Airport by British authorities (AW April 27, p. 41). Carrier says it is contacting a total of 15,000 passengers whose reservations will be affected by the change in schedules which were to have been effective April 26.

▶ Watch for West Coast Airlines to order three more Fairchild F-27 turboprop transports. Initial experience with the aircraft has demonstrated that the F-27 is quite compatible with the carrier's route pattern (AW April 20, p. 49).

▶ Official Red Air Force newspaper Sovetskaya Aviatsiya says American Boeing 707 and Lockheed Electra transports have "failed to live up to their high-pressure publicity buildup." Conceding that the 707 and Electra are fast and comfortable—"as befits craft designed primarily to carry people with fat pocketbooks"—the Soviet publication states that events have disproved claims of operational reliability.

▶ Local service airlines' load factors continued to rise during March. Overall load factor for six local service airlines climbed 1.82 points over March, 1958, with Bonanza, Lake Central and Allegheny showing the largest gains. Bonanza reached a load factor of 60% for the month, a 9.15% increase over the same month last year.

▶ Allegheny Airlines has leased one Canadair 540 turboprop transport from Napier Engines, Inc., for a three months period beginning July 1 to be used in scheduled operations on its Pittsburgh-Atlantic City-Washington route. Experience with the aircraft during the evaluation period will determine "the size and the timing of any order" the carrier may place for turbine-powered equipment. Initially, the airline will operate three daily round trips with the 540 between Pittsburgh and Atlantic City and one daily round trip between Atlantic City and Washington.

▶ Trans World Airlines reports a 96% load factor on Boeing 707 flights operating between San Francisco and New York. Turbojet service, which began Mar. 20, will be expanded to include first jet service between San Francisco and Los Angeles May 29.

▶ Federal Aviation Agency air carrier inspectors will receive flight and ground training on the Boeing KC-135 turbojet aircraft at the Merced, Calif., Air Force school. Total of 13 inspectors, assigned to certification of airline pilots, will take the flight course.

▶ Airlines are evaluating a special "emergency announcement tape recorder" device for installation on aircraft. Purpose of the equipment is to provide passengers with any announcements of emergencies automatically without diverting pilots from flight duties. For example, a recorded announcement instructing passengers to use oxygen masks would be automatically activated by a failure of cabin pressurization during flights at high altitudes.

▶ Pan American World Airways will make a bid to enter turbojet cargo operations. The airline is talking with leading U. S. manufacturers on the possibility of developing large cargo turbojets of intercontinental range that would cut cargo rates in half and permit the transport of ordinary mail and parcel post by air. In his report to stockholders, Pan American President Juan Trippe said "a fast jet especially designed for cargo, could handle five times as much cargo as present day piston engined aircraft."

SHORTLINES

▶ **Eastern Air Lines** has completed construction of a 2,205,000 gal. underground jet fueling system at Miami International Airport at a cost of $1,250,000. The system will be able to pump 11,000 gpm. to the 22 Eastern positions at the new terminal building. As Eastern's fleet of jet aircraft increases, the capacity of the storage area will be increased to 5,000,000 gal.

▶ **Canadian Pacific Airlines** reports a net year-end 1958 loss of $1.9 million, compared with a net loss in 1957 of $113,000. A major reason for the increased loss figure is a decrease in sales of aircraft, buildings and equipment in 1958, which was down from the 1957 figure of $1,545,000 to $412,000 for last year.

▶ **Iberia Air Lines of Spain** will reopen its route back into Mexico during May after a five year lapse in service. Iberia has reached agreement with Mexican authorities to reinstate the route operating from Madrid to Lisbon, Bermuda, Havana and Mexico City.

▶ **Pan American World Airways** flew its 50,000th flight across the Pacific Ocean on April 29. PanAm began Pacific operations on Nov. 22, 1935.

▶ **UAT French Airlines** carried 190,000 passengers over 640 million revenue passenger miles during 1958, increases of 25.2% and 17.3% respectively. Air cargo volume in 1958 was 26,400,000 lb., amounting to 92 million ton-miles. UAT serves Paris, Nice, Marseilles and Bordeaux in France and numerous cities and stops in the Middle East and Africa.

▶ **Panagra** is now offering combination first and tourist class service on all its flights between the U. S. and key South American cities. All of Panagra's Douglas DC-7 and DC-6B equipment now has been fitted out in the dual configuration.

▶ **Moscow's** proposed new Kazan Station post office building will have a rooftop heliport for fast mail transportation to and from the city's commercial airports.

▶ **Lake Central Airlines** reports a 30% increase in passenger boardings during the first two weeks of April as compared with the same period last year. The month of March recorded a 19.4% increase over March, 1958, with the first quarter, 1959, percentage increase up 11.7% over the January, February, March period in 1958.

LOOK UP!

THERE GOES...

TEXACO SYNTHETIC AIRCRAFT TURBINE OIL

As the commercial jets streak their vapor trails more and more frequently across the sky, you'll find Texaco up there flying with them.

Leading U. S. jet turbine manufacturers* have approved Texaco Synthetic Aircraft Turbine Oil 15 or EMS—and the airlines know and rely on the famous Texaco quality and aviation engineering service that have kept Texaco predominantly the leader in aircraft lubrication for the past quarter century.

Every lubricant characteristic essential to jet service is amply found in Texaco Synthetic Aircraft Turbine Oil —low viscosity at low temperatures, low volatility, good oxidation and thermal stability at high temperatures, non-corrosiveness to engine metals and excellent gear load-carrying ability. Its performance in high speed high temperature bearings under severe operating conditions has been proved outstanding.

Call the nearest of the more than 2,000 Texaco Distributing Plants in all States, or write:

The Texas Company, *Aviation Sales Department,* 135 East 42nd Street, New York 17, N. Y.

*PRATT & WHITNEY AIRCRAFT JT-3 and JT-4 engines used in Boeing 707s, 720s and Douglas DC-8s. GENERAL ELECTRIC CJ-805 engine used in Convair 880s. ALLISON 501-D-13 engines used in Lockheed Electras.

TUNE IN...Metropolitan Opera Radio Broadcasts Saturday Afternoons, CBS

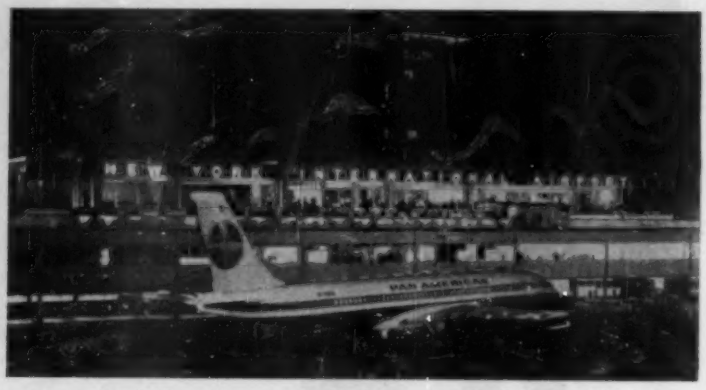
TEXACO

LUBRICANTS AND FUELS

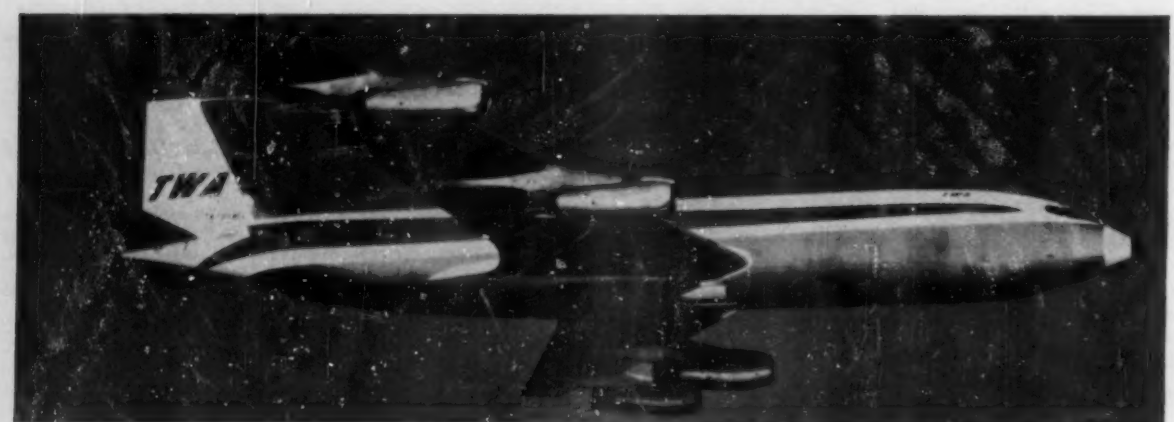
for Jet, Prop-Jet and Piston-Engine Aircraft

IN SERVICE, the Boeing 707 has set record after record, both for performance and passenger appeal. A Los Angeles to New York passenger flight was made in 4 hours, 3 minutes. During the first 60 days of this service, the 707 averaged a load factor of more than 95%, an unprecedented high in passenger appeal.

RESERVATIONS in the thousands for flights months ahead have poured in. A noted aviation writer reports: "The tremendous public acceptance of the 707s and their great revenue-producing ability have been among the most significant commercial-aviation developments since the Second World War."



THE 707 has broken all trans-Atlantic airliner records, flying New York to Paris in 6 hours, 4 minutes, and New York to London in 5 hours, 41 minutes. 707 passenger loads to Europe have been at record levels averaging a winter load factor of 94%. In addition, 707s carried up to 5 tons of mail and cargo each flight. Boeing jets are profit-making jets. Seventeen airlines have ordered a total of 190 Boeing jetliners—a reflection of confidence in Boeing, the world's most experienced builder of multi-engine jet aircraft.



707s NOW LINK San Francisco to New York in 4 hours, 50 minutes. Here again, 707s have set new records for speed and passenger appeal. Over both transcontinental and overseas routes, 707s have demonstrated tremendous earning power, extremely high initial utilization and unprecedented public acceptance.

BOEING
Family of jet airliners

These airlines already have ordered Boeing jetliners: AIR FRANCE • AIR INDIA • AMERICAN • B.O.A.C. • BRANIFF • CONTINENTAL • CUBANA • IRISH LUFTHANSA • PAN AMERICAN • QANTAS • SABENA • SOUTH AFRICAN • TWA • UNITED • VARIG • *Also* MATS

British Weigh Entering Supersonic Race

By John Tunstall

London—The British aircraft industry must enter the supersonic airliner race if it is to survive, according to opinions expressed by top management, production and design officials in discussion at a conference arranged by the Institution of Production Engineers at Southampton.

But if it does, the recent recommendations that the government should proceed with two relatively slow-speed supersonic aircraft and not with a Mach 3 vehicle (AW April 20, p. 43) were condemned as "commercial nonsense" by Peter G. Masefield, managing director of Bristol Aircraft Ltd. and president elect of the Royal Aeronautical Society.

There is a grave danger, he said, that to enter this field "too slow or too late" could lead to the total loss of the money expended. This, he said, could reach to $420 million each for the development of two types of airliner, to the certificate of airworthiness stage. And Britain's share of a total world requirement of 40 aircraft would not exceed 10, he estimated.

Time and time again during the discussion and in subsequent radio interviews, Masefield pleaded for a new committee having unprecedented power and including representatives from a wide field of commerce and the treasury to review with the utmost urgency the entire status of British aeronautics.

It was an "inescapable fact," Masefield predicted, that unless a forward policy for British aeronautics was implemented with adequate government backing forthwith, Britain would "fall behind forever" in maintaining her position as a world power. "There has never been such a time of decision," he added.

Industry Collapse Foreseen

The discussion, which resolved into whether Britain could enter this field in competition with the United States, followed the presentation of three papers on the theme "The Aircraft Industry—a National Asset." Several prominent industry authorities warned that unless Britain did commit herself very soon to a supersonic airliner project, the aircraft industry would quickly collapse.

On the other hand, not all the speakers believed that that was Britain's only course. It was futile, they said, to meet American competition head-on in this field.

It was possible that the aircraft requirements could diverge into two completely distinct categories. One would operate at high supersonic speeds and with relatively high aircraft mile costs and the other with low costs, a higher frequency, and at moderate subsonic speeds. It was in this field—medium-range subsonic jet airliners—where the United States was not heavily engaged, that perhaps Britain's future lay.

Its objective could then be the development of the mass market with this type of aircraft together with a new family of freighter aircraft and helicopters. Fares could be slashed to one-third their current value during the development phase.

Britain certainly could not tackle both categories of aircraft.

Envisaged was a subsonic Viscount-Convair arrangement for which a market worth several hundred million pounds was forecast. In this category Bristol is engaged with the Bristol 205 which has a twin-engine mounting at the tail and the de Havilland DH-123 with a STOL device, and probably de Havilland Gnome engines. Held up for lack of government support is the Handley Page laminar flow jet airliner, which though only of 30,000 lb., has a medium-range capacity due to its low drag characteristic.

Licensed Production

An alternative policy and one which should be vigorously pursued, according to Peter Masefield, involved Anglo-American collaboration, in the supersonic field. An acceptable arrangement might be the building of an American design under license, with British engines.

The real issue, however, and one clearly appreciated at the conference, turned on whether a manufacturing nation such as Britain could remain a first-class power without an extensive aircraft industry. A completely disproportionate part of the technological advance in all British industries in design, production, management and inspection since the war could be attributed to the aircraft industry directly or indirectly.

The collapse of this particular industry could devitalize in the long term the whole of Britain's industrial effort. Outside the aircraft industry (and excluding the nuclear field) the objectives or stimuli for research are not so tangibly or dramatically displayed, nor so vigorously pursued. Often, when research or development is not urgent, or is long term, it doesn't get done at all and several speakers cited Britain's shipbuilding and civil engineering industries among those declining because of this attitude.

The target for the aircraft industry was the supersonic airliner and it seemed generally agreed at the conference that it was unprofitable, if not useless, to engage in advanced aerodynamic research without it. Consequently it was feared the industry would soon dissipate its present strength and lose its key personnel if it were forced to concentrate in the subsonic regime where the problems were mostly solved.

Market Potential

The conference was also reminded that the United States was not likely to assure the British aircraft industry that it would remain permanently disengaged from the medium-range jet airliner because of Britain's predicament. If was, after all, that part of the spectrum—possibly the only part—where real profits would lie in the future. The total world requirement of supersonic airliners will not exceed 40, Masefield estimated.

Furthermore the loss of prestige incurred by withdrawal from the supersonic field could seriously prejudice not only the sale of its subsonic aircraft, assuming the likelihood of severe competition from Russia and the United States, but could well reflect unfavorably on British exports in general.

"The basic issue—whether we like it or not—" Masefield said, in his paper "The Industry Point of View," "is whether the aircraft industry in the United Kingdom can remain much longer in the 'big league' of military and civil aeronautics. Let us be clear that the 'big league' means expenditures on ballistic missiles, anti-ballistic missiles, supersonic transports, VTOL aircraft, perhaps nuclear powerplants later on and a comprehensive research program."

It was summarized, he said, by the urge to develop two supersonic airliners which would cost approximately $420 million each up to the certificate of airworthiness stage. "Can we afford it? Can we afford not to do it?" queried Masefield.

He brought out another serious problem affecting aircraft industries on both sides of the Atlantic—"the check in the ability of airliners to order new aircraft at a sedate but continuous pace sufficient to keep in steady employment design teams and production staffs, upon whom future progress must depend."

Elsewhere Masefield showed that by operating on 10 times the scale of the British aircraft industry and because of its longer production runs, U.S. aircraft are even less expensive than British aircraft in spite of America's high labor cost. He gave figures for sub-

YOU GET EXTRA CARE ON UNITED AIR LINES

LARGEST AIRLINE WEATHER CENTER CHARTS BEST-WEATHER ROUTES FOR YOU

"For your extra comfort, United has the nation's largest airline weather center, keeping us posted at all times as to where the best weather is," says veteran Captain Guy E. Cain. "Besides, radar on every plane 'X-rays' the sky up to 150 miles ahead day or night, showing us the smoothest path for your on-time arrival. And for the past five years United Air Lines has been studying the best high-altitude routes for your travel soon on Douglas DC-8 Jet Mainliners®." When you fly United, the regular fare buys *extra care* in every way.

UNITED AIR LINES ®

Continental's First 707-120 Delivered

Continental Airlines has received its first Boeing 707-120 jet transport. The airline will begin nonstop flights between Los Angeles and Chicago June 8 with four 707-120s, all of which are expected to be delivered this month (AW April 13, p. 47).

sonic jet aircraft on the order of $40 per pound British against $38.40 per pound American.

"Once supersonic passenger flight is achieved there is no forseeable end to the technical race," Masefield said. "The question bears repeating—should we now decide to engage in this race? If we do, the cost will be very heavy, but it may perhaps demonstrate the level of our national technical competence. If we do not, we shall be out of this particular competitive field for all time."

The question could be answered, he thought, only against the most fundamental and widespread government review of the whole status of British aeronautics. "What is required," Masefield emphasized, "is a new Brabazon/Cadman type committee at a high level sitting under an unbiased chairman who would command respect on all sides. It must number among its members representatives of industry, of commerce, the airlines, the manufacturers, the research establishments, economists and the ministries of supply and transport and the treasury.

"Only from such a study can the path ahead be determined with force and logic.

"One thing is quite clear. It is useless to tinker with these problems. We must get on—in selected spheres—or we must get out. If we decide to undertake specific tasks we must allocate adequate funds and research and manufacturing effort at them. Otherwise we must leave them alone. In aeronautics—as in any technical task worth attempting—once the sphere is defined it must be an all-out-effort—or nothing."

Masefield listed six points in the government resolution of Britain's aircraft industry's predicament:

- **Policy** of a strong British aircraft industry should be established, with clear objectives, within the financial terms decided.
- **Defined field** of endeavor should be set in the aircraft fields of transport, general aviation, manned military aircraft, guided flight and helicopters. Within each category clear—if limited—targets should be set in both civil and military fields.
- **State-sponsored** research and development programs should be planned within the specifically defined areas.
- **Final support** for a series of major projects should be determined—on the principle that what is worth doing at all must be done adequately; that research without production is useless.
- **Responsibility** of the state airways corporations for initiating the development of British aircraft to meet their future needs should be defined again with clarity and supported with money.
- **Policy** of encouraging British aeronautics generally should be established, with particular reference to both the independent operators and to general aviation, thus leading from the foundation of a healthy home market to expanding export sales.

The effect of future Soviet competition and the impact of the European common market on Britain's aircraft industry were among other topics aired at the conference.

The conference was assured that Soviet aircraft sales were not likely to be significant in the West. "We have learned ourselves," one manufacturer mused, "how difficult it is to get full certification for one's aircraft in other lands." What the Russians might well do, said one prominent management official, would be to mount some airline opposition with its giant, long range and highly economic Tu-114, and break the IATA fare structure. "This would be the best thing the USSR has done for years."

Other speakers at the conference thought the development of the common market could be "disastrous." Britain was losing out fast in Europe, warned one manufacturer, because of a lack of political awareness, and a failure to get in the act.

BEA Load Factor Drops, Passenger Miles Increase

London—British European Airways has marked up its fifth consecutive profitable year, despite the recession in air traffic last year, according to preliminary reports.

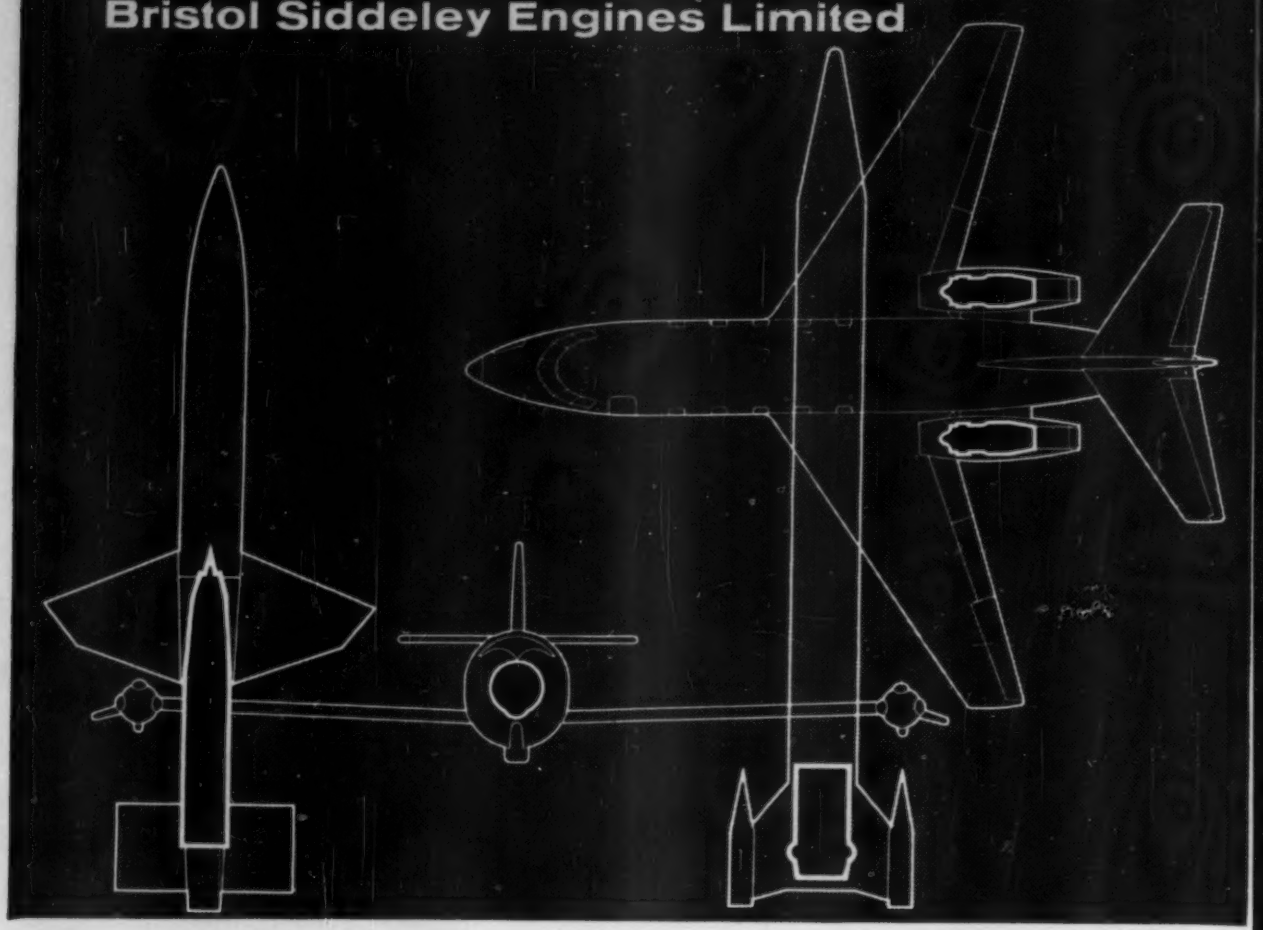
Lord Douglas, BEA board chairman, reported passenger miles flown increased 5.6%, compared with an average increase of 16% in the previous 10 years.

The load factor dropped from 68.5% to 62.5%.

Annual income was aided by Easter holiday traffic which set new records, topping the previous 1957 high by more than 3%.

BRAIN POWER

Bristol Siddeley Engines Limited



THE CHALLENGE. The changing face of aviation demands further development of established powerplants; demands design of new forms of power; demands the right engine at the right time in the right quantity.

ANSWERED BY A GREAT NEW COMPANY Bristol Siddeley Engines Limited allies the minds, skills, resources of Bristol Aero-Engines and Armstrong Siddeley Motors to form a new giant of immense capability, immediately equipped for a dominant role in world aviation.

Already Bristol Siddeley presents a great range of powerplants, extending over the whole field—turbojets, jet-props, ramjets, rocket motors, piston engines. All outstanding in design and performance, developed and produced by the partner companies individually.

It has factories equipped with the most modern machinery to implement modern production methods, and a highly skilled labour force maintained through its own advanced apprentice training schools.

More important—Bristol Siddeley possesses a vast complex of test plants which can simulate *now* the extreme conditions of flight in the future.

And behind all these resources stands the most vital: the research, design and development brain power that will keep Bristol Siddeley ahead in answering the challenge of modern aviation.

Famous Bristol Siddeley Engines:—

SAPPHIRE—turbojet . . . high subsonic and supersonic speeds . . . powerplant of the Javelin all-weather interceptor and the Handley Page Victor bomber.

PROTEUS—most powerful jet-prop in airline service . . . remarkable mechanical excellence and exceptional reliability . . . in the Bristol Britannia.

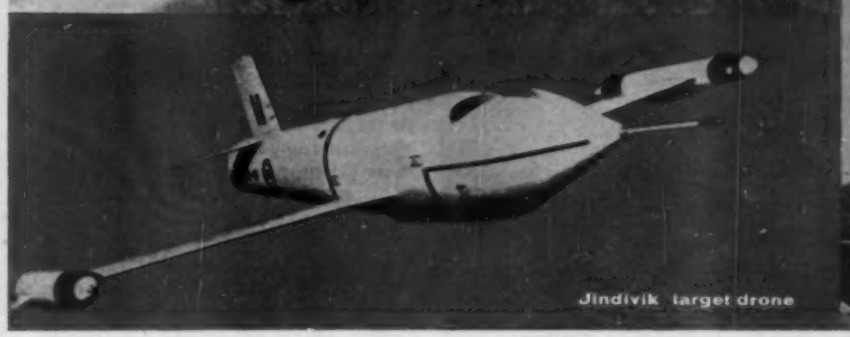
VIPER—turbojet . . . exceptional handling qualities . . . powers the Hunting Jet Provost, RAF's basic jet trainer, and the Jindivik pilotless target aircraft.

ORPHEUS—leading lightweight medium-thrust turbojet . . .

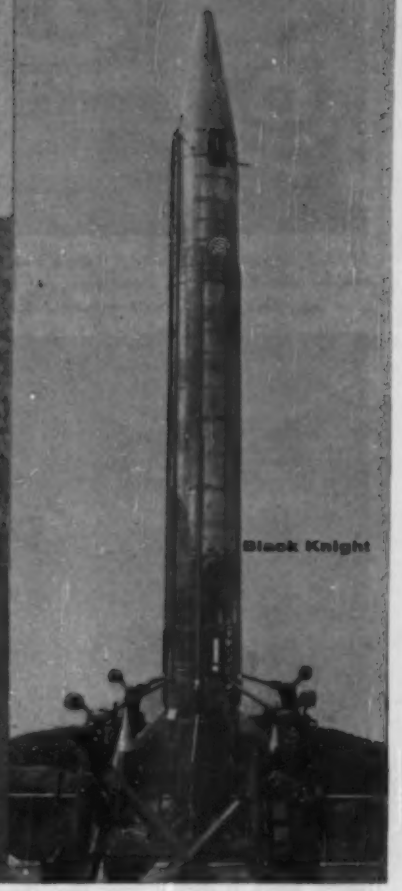
FLIGHT POWER

Lockheed Jetstar

Bristol/Ferranti Bloodhound



Jindivik target drone



Black Knight

already specified in 8 countries for 14 different aircraft including the outstanding Lockheed Jetstar.

SINGLE MAMBA—jet-prop . . . stressed for naval operations such as deck landing and catapulting . . . installed in the Short Seamew.

THOR—a fully developed ramjet engine . . . powers the Bristol/Ferranti Bloodhound guided missile system, chosen as Britain's major air defence weapon, ordered by Sweden.

GAMMA ROCKET MOTORS—developed and produced as the power unit of the successful Black Knight research rocket.

OLYMPUS—turbojet . . . remarkable for great power at high altitude and very low fuel consumption . . . powerplant of the Avro Vulcan bomber.

DOUBLE MAMBA—jet-prop . . . virtually twin-engined reliability for long oversea reconnaissance duties . . . powers the Fairey Gannet.

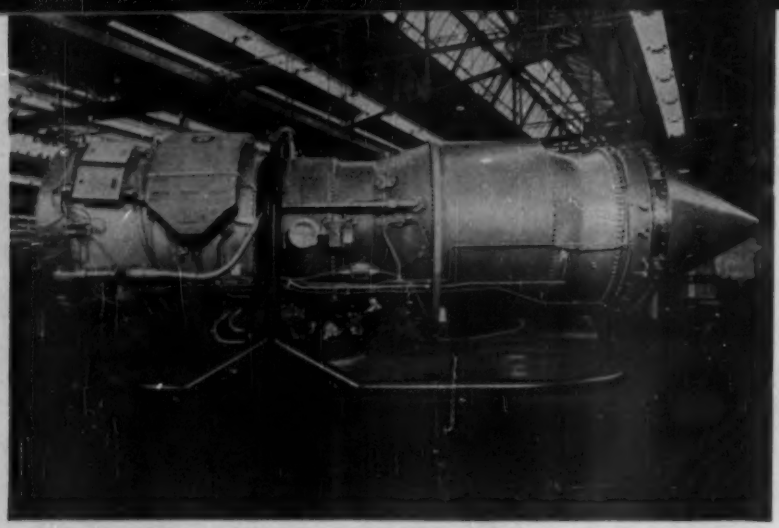
CENTAURUS AND HERCULES—two radial piston engines, with Bristol-pioneered sleeve-valves . . . renowned for their reliability and long overhaul life.

P181, P182—turboshafts . . . remarkably compact for power developed . . . P181 designed for helicopters, P182 for fixed-wing aircraft.

Bristol Siddeley

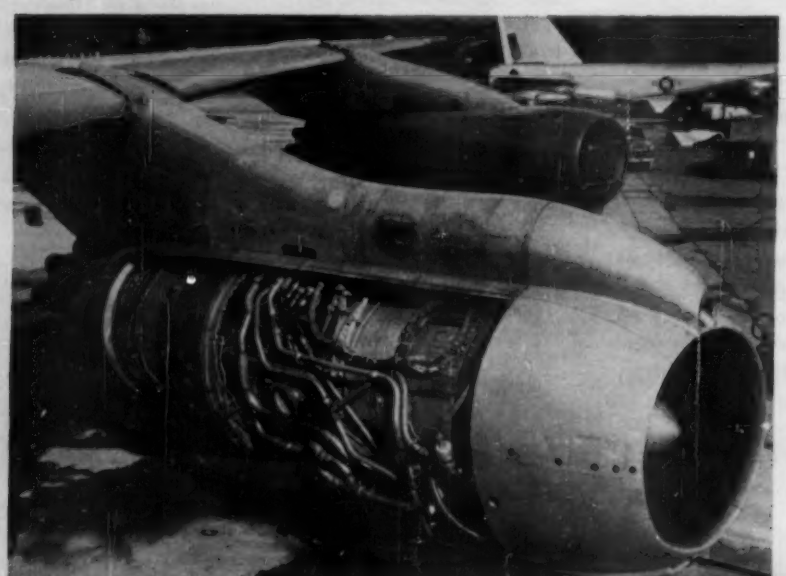
ENGINES LIMITED

BRAIN POWER translated into FLIGHT POWER



JT4A-3 commercial engine on dolly is one of the first production models ready for delivery this month. Engine has about same outside measurements as JT3 (J57) but its hub-to-tip ratio is smaller and it is more powerful, handling more air.

FLIGHT TESTING of the JT4 engine has been conducted for the past 16 months by Boeing in the 367-80 aircraft (above), the original experimental model of the 707. Over 466 flight hours have been accumulated. Developmental JT4 is mounted in the inboard pod (above) which is slightly larger than the outboard pod which houses a JT3 turbojet. Close-up of the JT4 pod is below. Turbofan versions of the JT4 will exhaust fan air well forward on the nacelle. Fan air exhaust will be approximately where forward cowl ends in the picture below.



JT4 Designed

By J. S. Butz, Jr.

East Hartford, Conn.—Pratt & Whitney Aircraft Division of United Aircraft Corp., scheduled to deliver its first production JT4 commercial version of the military J75 turbojet engine sometime this month, has moved to meet an expected growth in the size of subsonic jet transports by planning a 50% growth factor into this basic engine design during the next few years.

Family of JT4 engines as laid out by Pratt & Whitney includes four versions, culminating in a 25,000-lb.-thrust turbofan. All of the advanced engines utilize a large percentage of parts from the first production model, the JT4A-3, which has a rating of 15,800 lb. thrust.

JT4A-9 Delivery

Second engine rated at 17,500 lb. thrust and designated the JT4A-9 should be available by the middle of next year. Only parts replacement required to convert the first JT4 model to this more powerful version are the turbine inlet nozzles and the first two turbine stages. Thrust improvement will be gained primarily through use of more advanced materials in these parts.

Third engine in the family will be a 22,500-lb.-thrust turbofan, the JT4D-3. This engine will utilize the fan section from the JT3D-1 (turbofan version of the J57 military engine). While the JT4 is much more powerful than the JT3, it is possible to use the same fan section on the front of both engines because the inside diameter of the air path in their compressor sections is about the same. Reduction in cruise specific fuel consumption will be about 8%, using this JT3 fan on the front of the JT4. It also will be necessary to add a fourth turbine stage to the engine to provide sufficient power to the fan section.

Last engine in the family will be a turbofan of 25,000 lb. thrust with the fan section designed especially for the JT4. This fan section will have a bypass ratio of about 1.5, indicating that 1.5 times more air passes through the fan than through the main part of the engine. Specific fuel consumption with this engine will be reduced by between 12 and 15% in comparison with the first JT4 production model, the -3.

Reason the second turbofan version of the JT4 will have better fuel consumption than the first is its higher bypass ratio. The JT3 (J57) fan section with its smaller outside diameter provides a bypass ratio of only 0.8 as op-

for Growth as Transport Size Increases

posed to 1.5 for the larger engine, and fuel consumption on a turbofan depends almost directly upon this bypass factor.

While the first two engines in the JT4 family are in production or well along in their development cycle, the second two have not yet progressed beyond the preliminary design stage. Detailed design and development of these fan engines will not be pursued by the company unless military interest is shown or large airline orders are received.

In the majority of cases in the past, the most appealing engines commercially were developed by the services and spent long years in military use before appearing on the civil market. This pattern has appealed to the airlines because they can buy proven engines which are less expensive since a major percentage of the development costs have been amortized during the military program.

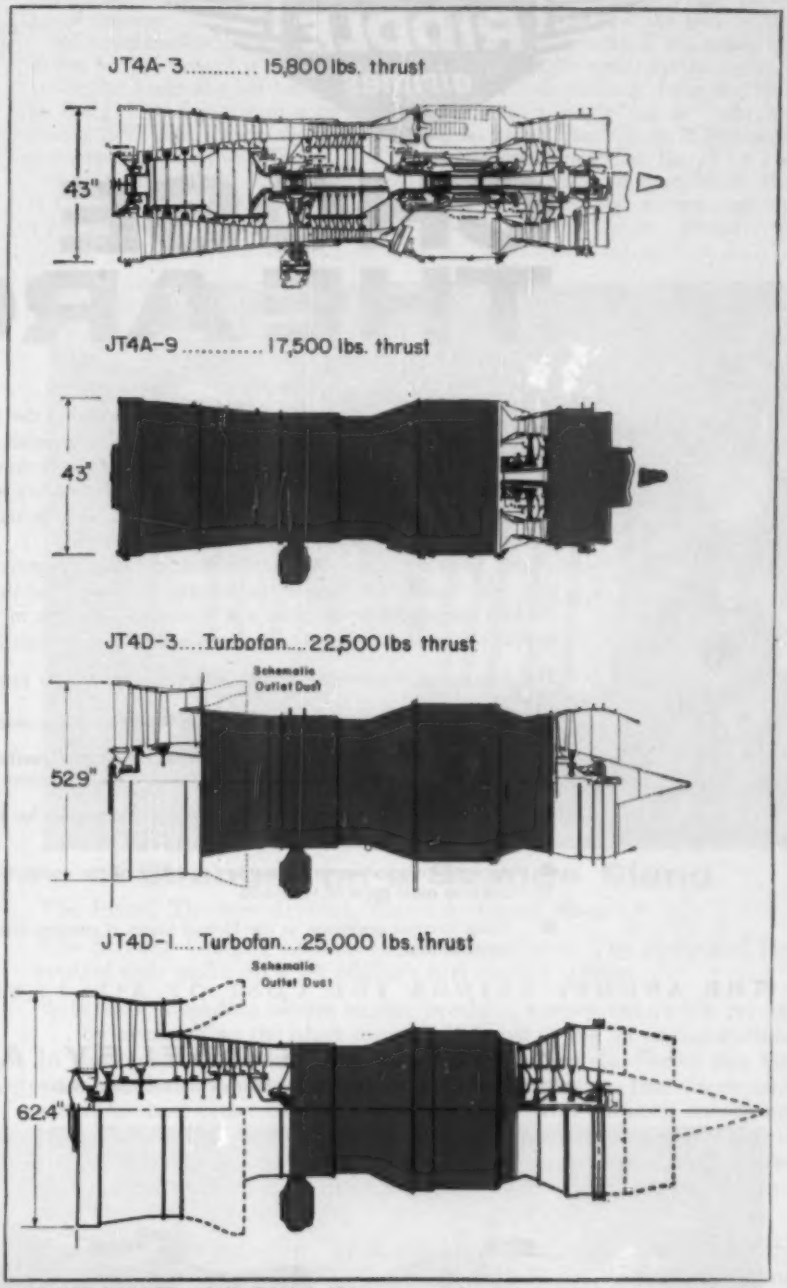
None of the engines in the JT4 family have been developed under these circumstances. The J75, military counterpart of the JT4-3 now ready for commercial service, has not been in use for any extended period in any aircraft. Various versions of the J75 are installed in the Martin P6M-2, Republic F-105, and Convair F-106, none of which is high-time aircraft as yet. Experience also was gained in the North American F-107, Chance Vought F8U-3 and the Avro CF-105 before they were terminated.

Pratt & Whitney followed two main courses to compensate for its relative lack of running time and prepare the JT4 for commercial sale:

- **Service experience** with the 10,000-lb.-thrust-plus J57, which has several years of extensive military use behind it, was cranked immediately into the J75 and JT4 programs.
- **Accelerated tests** were run on the engines by the Air Force, Boeing Airplane Co. and Pratt & Whitney.

Aid from J57

It was possible to make rapid and significant use of the JT3 (J57) experience in the J75 program because of the great similarity between the engines. Both have twin spool compressor sections; they use the same materials and general design techniques; their compressors have the same high compression ratio of about 12 to one in order to achieve the best possible fuel consumption in the high subsonic speed range, and both have approximately the same



PLANNED GROWTH of the JT4A-3 (J75) commercial turbojet is shown above. All of the engines in this family use major parts assemblies from the original -3; these are shown in red. Conversion to the more powerful versions of the JT4 may be made in an overhaul facility without rework of the sections in red. First turbofan, the JT4D-3, uses the forward fan section from the JT3 (J57) turbofan which is now in development. This engine reduces specific fuel consumption about 8%. Fan section designed specifically for the JT4 used in the bottom engine will reduce fuel consumption 15% over the JT4A-3. Bottom two engines will not be taken past preliminary design until a commercial or military requirement is established. The JT4A-3, the first production engine, weighs 5,020 lb.

WHY

RIDDLE airlines

CHOSE THE ARGOSY

More air freight is carried in the United States than in the rest of the world combined — so it is no wonder that the U.S. operators are more cost-conscious. That is one of the reasons why Riddle Airlines Inc. have placed a provisional order for the Armstrong Whitworth 650 Argosy. This major break-through in the dollar market is a tribute to the economics of this new British aircraft — the world's first pressurised turboprop freightercoach.

Mr. George L. Giles, President of Riddle Airlines, comments: "Apart from its lower direct operating cost, the Argosy will benefit the indirect expenses, due to lower handling costs . . . The AW.650 is the first aircraft to be designed and produced with this in view. With minimum reorganisation, the Argosy's quick loading and turn-round will save us at least 20 per cent on handling alone".

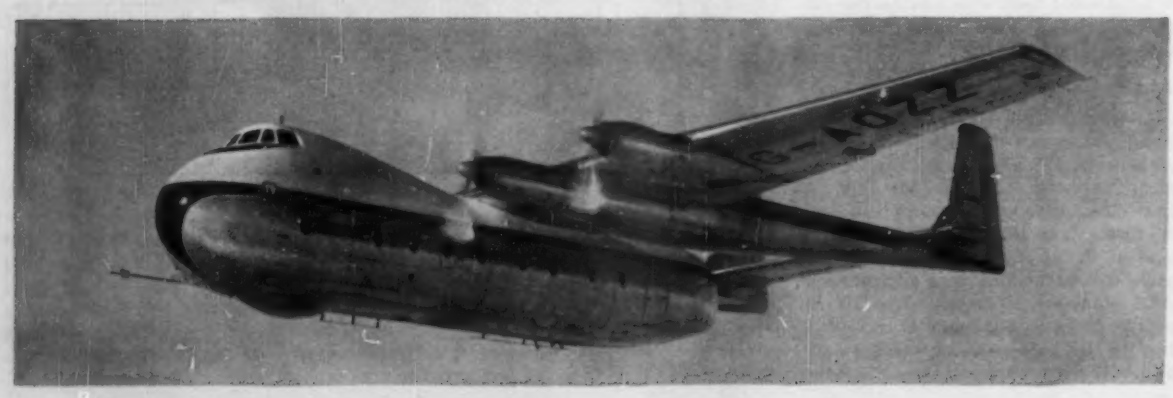
The Armstrong Whitworth Argosy offers cheaper freight rates because:

1. It is 30 per cent cheaper to operate than Riddle's existing twin-engined freighters.
2. The refined loading systems available with the aircraft, together with a full-width freight door at both ends of the fuselage, give rapid turn-round and help to reduce indirect costs to a minimum.
3. The Argosy is extremely simple to service — accessibility has been built in to the design — and it can operate from semi-prepared strips.
4. An extensive service organisation for many of the components — chosen for proven reliability — already exists in most parts of the world.
5. Coast-to-coast operation in the United States is possible within 24 hours, with only one traffic stop or as many as four.

THE ARGOSY BRINGS THE COST OF AIR FREIGHT DOWN TO EARTH

HAWKER SIDDELEY AVIATION LTD

Richmond Road, Kingston-upon-Thames. *International Sales Office*, Duke's Court, St. James's, London, S.W.1.



turbine inlet temperature. The JT4 has a lower hub-to-tip ratio and a larger air capacity, which accounts for its greater power.

Primary difference between the design of the engines, however, is that the J75 must be more sophisticated to achieve a similar thrust-to-weight ratio, since it is easier to achieve a high thrust-to-weight ratio with a small engine than with a large one.

Evidence that J57 information has been put to maximum use in the J75-JT4 programs is the fact that the thrust-to-weight ratio of the first JT4 engines is about 3.1 at takeoff. This is approximately the same as the thrust-to-weight ratio of the latest model of the JT3.

In effect, the J75 and JT4 engines were absorbed into and received the benefit of the long modification and testing program of the J57 and the JT3. This modification and testing program is the heart of Pratt & Whitney's philosophy concerning the development of engines.

Development Philosophy

First precept of this philosophy is to make the initial experimental engine of any series a rather heavy, conservative engine designed so that there is as little doubt as possible about its functioning. Several of these experimental engines are then constructed and test run as much as facilities will permit.

It is believed by Pratt & Whitney engineering that the large number of hours and mass of data which can be rapidly accumulated on such experimental engines makes it possible to develop a good operational engine in the shortest possible time. All major problem areas are usually pinpointed during this extensive prototype testing program, and the data collected is used immediately to lighten and improve the design.

For example, the thrust-to-weight ratio of the JT3 prototype in 1951 was around 2.0. On the first production engine two years later it has been improved to about 2.22. This development program has been continued without let-up, and the thrust-to-weight ratio of the latest version is better than 3.0.

Pratt & Whitney management has helped make this development philosophy effective by providing probably the largest privately owned facilities in the world for the experimental testing of engines under all operating conditions. Primarily grouped within the Willgoos Laboratory, these facilities represent a capital investment of more than $100 million.

The J75-JT4 program also has had the benefit of some unusual accelerated testing to compensate for its limited operational military use. Pratt & Whitney has taken one JT4 engine through three consecutive 1,000-hr. tests and has just begun a fourth series. Each of these 1,000-hr. tests is conducted to approximate airline operation with periods of taxi, takeoff, climb, cruise, let-down power, etc., corresponding to trips of from three to seven hours. The engine has been torn down, inspected and given a major overhaul after each 1,000 hr. of running.

No major trouble has developed, even in the first of these 1,000-hr. tests.

The Air Force also has built up time on the J75 by flying it in a modified Boeing B-52 with J75s in the outboard pods replacing the two J57s.

Boeing began flight testing the JT4 in December, 1957, by installing one in a pod of the original experimental 707. Four hundred and sixty-six hours have been logged by this aircraft since it began flying with the JT4.

Major difference between the JT3 and JT4 designs is in the first four compressor stages. The rotating blades in these stages had to be longer on the JT4 than on the JT3, yet their weight could not be greater if the prescribed thrust-to-weight ratio was to be met. To solve this problem, Pratt & Whitney used a single pin to hold the blades rather than the more customary fir tree attachments on the JT3. The blades were made of titanium so that their base could be narrow and the pins would provide an adequate at-

Stranger on a Strange Stand

The Place: The new Airwork-Miami Accessory Shop.

The Strange Looking Devices in the Foreground: The pump and fuel control that make up a jet engine's fuel control system.

With this, a leading piston engine overhaul agency enters the jet age . . . by overhauling the most complicated unit in the jet engine system. In the process, Airwork will set new performance standards, too. For example, the flow meters on Airwork Test Benches are four times more accurate than those used in current stands. And Airwork stands are so made that they can accurately simulate the operating conditions of any of the test stand systems now in use by accessory and engine manufacturers. This makes it possible to check any of today's performance standards on one stand!

You may not be flying jets for several years. But, when you do, Airwork will be ready with the skills, the equipment, and the industry leading standards they have already established for piston engines. Quality in jet accessory overhaul will be ready for you—when you are ready for jets.

Airwork CORPORATION
Millville, New Jersey

BRANCHES IN:
WASHINGTON
NEWARK • MIAMI • ATLANTA
CLEVELAND

JET-PROP power turns the Convair into a profit-producing Jet Age aircraft . . . the Canadair/Convair 540 . . . with a long and profitable service life. You can have a jet-prop Canadair/ Convair 540 in one of two versions:

VERSION A . . . Canadair, Ltd. . . . a subsidiary of General Dynamics Corporation . . . offers you a new production line aircraft powered by Napier Engines.

Or, VERSION B . . . Canadair will replace the piston engines of your present Convair 340/440 with Napier engines.

Either way, the economy and performance are identical.

And, the smooth new Napier Eland 3500 HP jet-prop engine: • holds first FAA certification for jet-prop conversion of Convairs • makes possible direct operating costs as low as 1.1c per seat mile • reduces climbing time to 20,000 ft. by 56%—and increases cruising speed as much as 64 mph • triples range with maximum payload • lowers break-even load factor as much as 7 percentage points • and increases aircraft revenues through passenger enthusiasm for smooth, swift jet-prop air travel • For more complete technical data, write today to: Napier Engines, Inc., 909 Dupont Circle Building, Washington 6, D.C.

NAPIER AERO ENGINES INC.

A SUBSIDIARY OF D. NAPIER & SON, LTD., LONDON, ENGLAND • A MEMBER OF THE ENGLISH ELECTRIC GROUP OF COMPANIES

Pratt & Whitney J75 and JT4 Specifications

First detailed specifications of military and civil versions of Pratt & Whitney Aircraft J75 series turbojet, recently cleared by Department of Defense, show current military versions with power ratings from 15,800 lb. thrust to 26,500 lb. thrust (with afterburning and water injection) and civil models ranging from 15,800 lb. thrust to 16,800 lb. thrust.

Manufacturer	Designation	Type	No. compressor stages	No. turbine stages	No. combustors	Max. power @ S.L.	Specific fuel consumption at max. power, lb./hr./lb. st. cruise	Compression ratio at max. rpm.	Max. envelope diameter, in.	Max. envelope length, in.	Dry weight, less tailpipe, lb.	Remarks
United Aircraft Corp. Pratt & Whitney Aircraft Division E. Hartford Conn.	JT4A-3, -5	AFJ	15	3	8	15,800	0.78	12	43	144.1	5,020	—5 weight, 4,815 lb.
	JT4A-9, -10	AFJ	15	3	8	16,800	0.81	12	43	144.1	5,020	—10 weight, 4,845 lb.
	J75-P-2	AFJ	15	3	8	15,800	0.77	12	43	146.4	4,960	Non-afterburning JT4A-4.
	J75-P-17	AFJ	15	3	8	24,500	2.15	12	43	237.6	5,875	Afterburning JT4A-28.
	J75-P-19W	AFJ	15	3	8	24,500[1]	2.15[1]	12	43	259.3	5,960	Afterburner, water injection.

[1] Wet power rating is 26,500 lb. t.; sfc. is 2.20.

tachment. These four stages of loose pin-jointed compressor blades give the JT4 a distinct clattering noise as the engine is shut down.

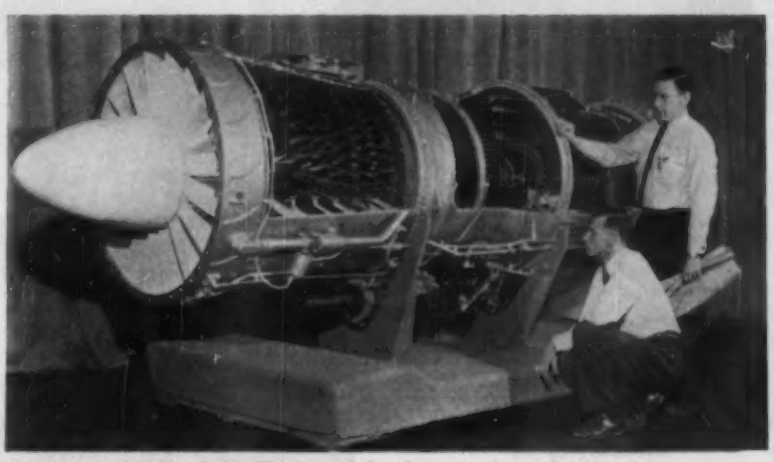
Airlines are being given a choice of two engines in each of the four thrust ratings in the JT4 family. One of the engines in each class is made primarily of steel; the other uses more titanium. The steel engine is heavier, but its initial cost is lower.

The JT4A-3, the first production engine, weighs 5,020 lb., and the only titanium used in it is in the first four low-compressor stages. The titanium engine—the JT4A-5—being offered with this same thrust rating uses titanium throughout the low-pressure rotor for blades and disks and in the first three high-pressure compressor stages. This engine weighs 4,815 lb.

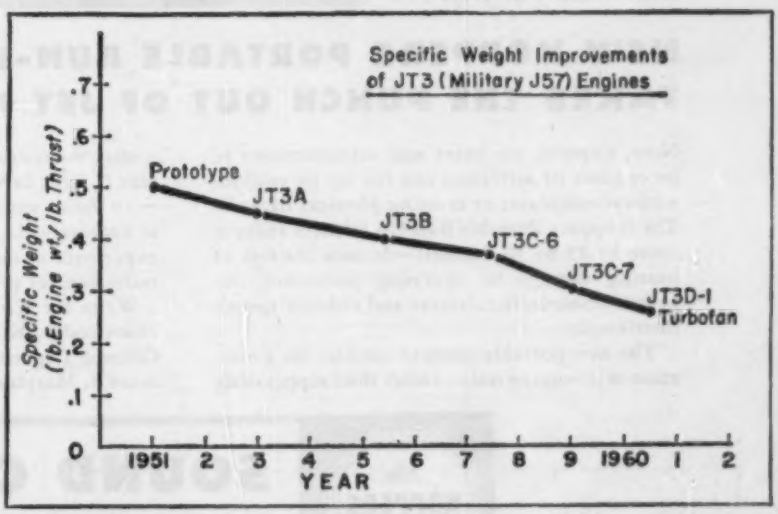
Military services save even more weight by using a titanium case for the low-pressure rotor on their J75s.

The two forward fan versions of the JT4 follow the general plan for building bypass turbojets that Pratt & Whitney has followed. Bypass air is taken in at the very front of these engines and passed through two or three rotating compressor stages. The air is then exhausted well forward on the nacelle and travels aft to mix with the higher velocity gas stream exiting from the main part of the engine. Pratt & Whitney tests have shown that this method of exhausting the bypass air does not increase nacelle drag and that the propulsive efficiency of the engine is increased as much as if the bypass and main air were mixed internally.

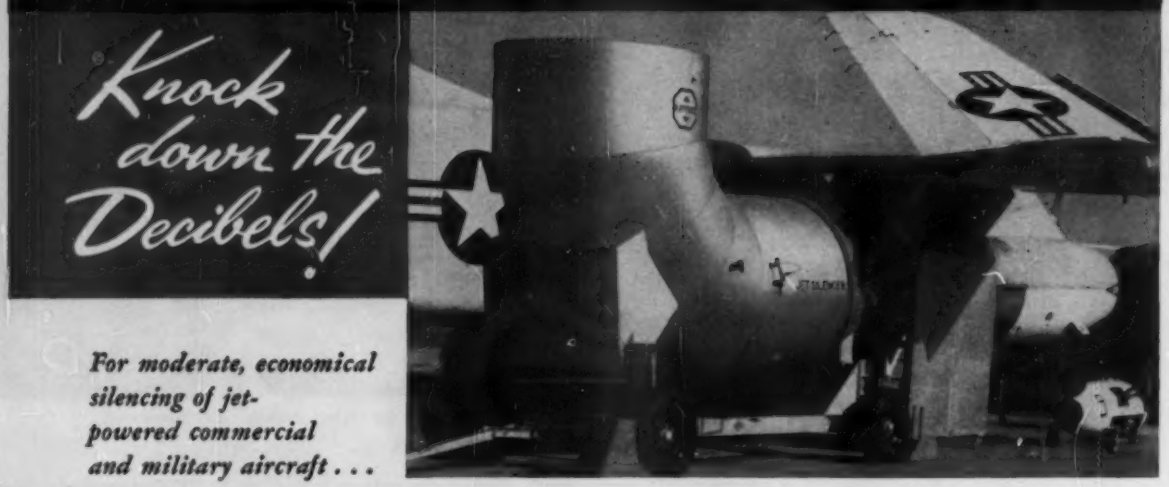
The very long compressor blades required by this type of fan engine are primarily the result of Pratt & Whitney's development of J91 nuclear turbojet. These very long blades are supported by a shroud located at approximately the mid point of their span.



CUTAWAY MODEL of the JT4 is used for demonstration and instruction.



PRATT & WHITNEY philosophy of engine development is illustrated here. The company first designs conservative experimental engines which will run for long periods. The mass of data thus obtained is used continuously to lighten and improve the design.



For moderate, economical silencing of jet-powered commercial and military aircraft . . .

NEW KOPPERS PORTABLE RUN-UP SILENCER TAKES THE PUNCH OUT OF JET NOISE

Now, airports, air bases and manufacturers of jet engines or airframes can run up jet engines without complaint or creating physical hazards. The Koppers Portable Run-Up Silencer reduces noise by 25 to 30 decibels—lessens the risk of hearing damage to operating personnel, improves community relations and reduces speech interference.

The new portable silencer inhibits the generation of jet engine noise, rather than suppressing it after the noise has reached full intensity. The unit is light in weight and completely portable—no direct attachment to the aircraft or engine is necessary. Look to Koppers with its longest experience in the industry to solve your aviation noise control problems.

Write for Koppers new sound control brochure today. KOPPERS COMPANY, INC., Sound Control Department, 3505 Scott Street, Baltimore 3, Maryland.

Official United States Navy Photographs

KOPPERS

SOUND CONTROL

Engineered Products Sold with *Service*

Sikorsky Envisions Supersonic Airliner

Stratford, Conn.—Razor-edge-thin airfoils or wedge-shaped airfoils may be only the second best way to fly efficiently over the entire speed range from conventional takeoff and landing through Mach 2-3 as in the case of a supersonic transport, a report by Sikorsky Aircraft engineers suggests.

A supersonic transport conceived by Michael E. Gluhareff, Sikorsky engineering manager, illustrates this approach:

- **Wing** is moderately thick, about 6% in relation to chord. Because of the long chord, however, this makes for a thick wing in practical fact and advantage is taken of this for fuel storage.
- **Leading edge** is convex, designed for elliptical lift distribution.
- **Aspect ratio** is 1.27 which is held to be superior in the required highly swept delta range of 1 to 1.3 in stability characteristics at all speeds and relatively unsusceptible to drag rise in the transonic region.
- **Rounded leading edge** provides for maximum heat dissipation and provides high lift coefficients at low speeds.

Although not indicated on the three-view, the vertical fin would probably be redesigned so that its maximum area would be on the underside of the wing, not on top. Because delta wings at low speeds produce lift due to immense tip vortices, the aircraft would be considerably more stable with the fin removed from the area of the vortex.

The design is based on the use of four advanced version Pratt & Whitney J58-C turbojets in the 30,000 lb. thrust class and capable of delivering high thrust at Mach 2.5 at altitudes on the order of 50,000 ft. Gross weight is approximately 300,000 lb.—about the same as the long range Douglas DC-8 or the Boeing 707-320, and the payload of 40,000 lb. is in the same general class with these aircraft.

Range is computed at 3,600 mi. with reserves at Mach 2-3, based on a fuel weight of 150,000 lb. and a structural weight of 110,000 lb.

Sikorsky, at least at the moment, has no intention to build such a transport. However, the design has been shown to Pan American World Airways. Sikorsky would like to see these ideas developed by others, particularly a high-trimmed-lift device which Sikorsky is wind tunnel testing.

One direction these studies may be taking is indicated by a design for an advanced high speed single rotor single blade vehicle Sikorsky showed in an exhibit to United Aircraft Corp. stockholders at the annual meeting. This vehicle, designated the S-57, uses the same convex wing planform with the fin mounted on the underside. The transport concept, which envisages a form of double-bubble construction for its two level passenger pressure cabin, has a number of other design features:

- **Fuselage** follows the area rule, utilizing the natural taper of the fuselage in relation to the aft placement of the delta wing to obtain the proper cross sectional area.
- **Retractable canard** surfaces are used with the leading edge high lift device for high trimmed lift coefficient at low speeds.
- **Retractable fins** on the wing underside are raised at high speed, extend at low speeds for roll damping. Due to the high sweepback, the planform itself shows practically neutral stability without any fins at low lift coefficients as would be found at high speeds.
- **Elevons are outboard** of the wing semispan for minimum low speed control interference. The control surfaces are hinged along a line perpendicular to the wing vortices rather than arbitrarily perpendicular to the wing chord.

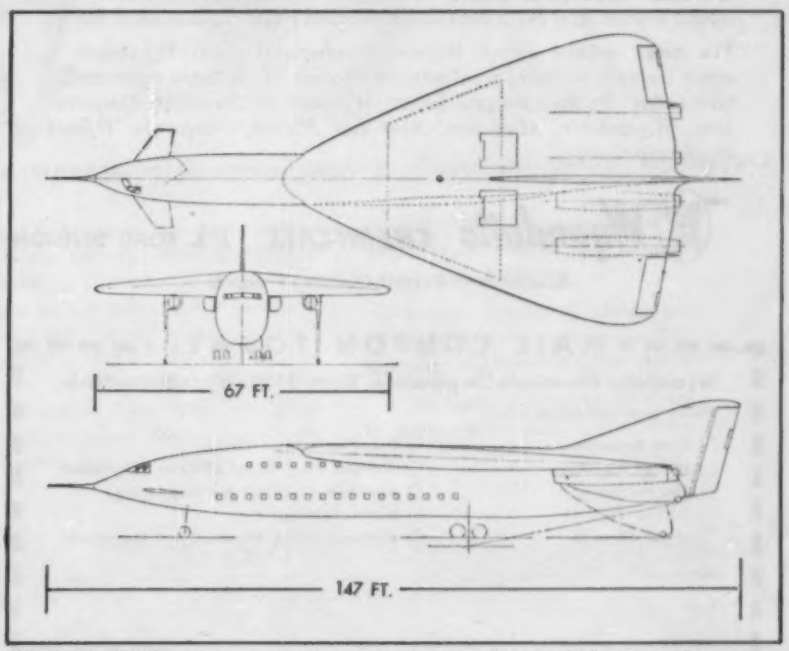
The Sikorsky report on the convex wing, or referred to in some variations as the heart wing or planform wing, questions half a dozen assumptions on delta wings. One is that the delta must have the planform on an equilateral triangle, with 60 deg. sweep and an automatic aspect ratio of 2.31 with relatively low pitching stability at low lift coefficients. Another is that the delta should have the same thickness and leading edge configuration that straight wings have and that the section is constant with span.

The report emphasized that the flow on a delta is primarily three dimensional, not two, and that aspect ratio is critical throughout the speed range from 100 to 2,050 mph. At low speeds and high angles of attack, the immense tip vortices sweep the whole upper surface of the wing. Strength of these is described as so great that the airflow over the entire wing, not just in boundary layer but in depth, follows the path of the vortex flow, energizing the velocities over the top portion of the wing. These vortices must be properly spaced for maximum effect as well as lift/drag considerations; thus the emphasis on the 1.27 aspect ratio.

At high speeds three-dimensional flow is not easily visualized, but it is known that as long as the leading edge is far enough behind the shockwave, subsonic flow might be generated and thus aspect ratio is determined up to Mach 2.5 by this required sweep of the leading edge.

Though it would seem different aspect ratios would be needed to best meet conditions at each end of the speed scale, the report said that in the 1 to 1.3 range the optimum is reached at 1.27, which is also the aspect ratio of a circular disk.

In the low speed range, a maximum



SIKORSKY DESIGN for a supersonic transport has a moderately thick wing with a convex leading edge. Design includes retractable fins on the wing underside.

Introducing Wyandotte's new

BUZZ

MODERN PAINT REMOVER

BUZZ IS VERSATILE! Apply it by spray, brush, or flow-on method. Buzz removes paint and exhaust stains from all aircraft metals. Also ideal for ground support equipment (ramps, trucks, etc.).

BUZZ IS APPROVED! Meets all requirements and has received Air Force approval under MIL-R-25134 (USAF). Designed especially for the new Air Force paints.

BUZZ IS SAFE! Non-flammable. Non-corrosive. It is based on one of the safest of all chlorinated cleaners — methylene chloride.

BUZZ IS VISCOUS! Adheres to vertical and overhead surfaces. Yet Buzz can be easily removed by rinsing with water.

BUZZ "STAYS WET"! Contains evaporation retarders for longer action. And Buzz contains no abrasive materials or inert fillers.

For more details about Buzz — or information on Wyandotte's other aircraft-cleaning products — call your Wyandotte representative today. Or mail coupon below. *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Also Los Nietos, California. Offices in principal cities.*

Wyandotte CHEMICALS J. B. FORD DIVISION

Specialists in Aircraft-Cleaning Products

MAIL COUPON TODAY!

Wyandotte Chemicals Corporation, Dept. 3120, Wyandotte, Mich.

Please send information on:

- ☐ Paint Removing
- ☐ Aircraft Cleaning
- ☐ Electrocleaning
- ☐ Carbon Removal
- ☐ Metal Cleaners
- ☐ Removing Exhaust Stains
- ☐ Chemical Products for Airframe Manufacture
- ☐ Aluminum Cleaning and Brightening
- ☐ Barrel Finishing
- ☐ Chemical Milling Aluminum and Magnesium

Name_____ Title_____

Firm_____

Address_____

City_____ Zone_____ State_____

lift coefficient is found here as well as a stable pitching moment curve with no reversals with angle of attack. Stall is very gradual. Furthermore, the report says, the slope of the lift curve at low angles has a characteristic dip which would allow for high speed flight in rough air. This is because the change of lift coefficient with angle of attack is considerably less than for a higher aspect ratio wing.

Based on tests by the National Aeronautics and Space Administration and the Royal Aircraft Establishment, the report noted that:

- **Induced drag** (drag due to lift) can be reduced — at low lift coefficients around 0.2 as much as 50%—in a wing designed for constant coefficient of lift as against a twisted wing having a straight leading edge.
- **Wave drag** at Mach 1 is approximately 25% less than the equivalent delta with a straight leading edge.
- **Adding area rule** to these, transonic drag rise is reduced to a small amount.

Lower Drag

The Sikorsky report adds further that comparing a 1.27 aspect ratio delta wing with subsonic airfoil against a delta with 60 deg. sweep and wedge airfoil, the subsonic wing has 50% lower drag, its lift/drag ratio is 30-40% better and the pitching moment is on the order of 5% of the pitching moment of the higher aspect ratio delta. Thus the drag or power required for trim for level flight for the low aspect ratio wing is negligible up to Mach 2.4.

These figures are called conservative, since the report contends that wing drag of a properly designed low aspect ratio delta is perhaps half that of a straight wing of the same area. Thus, it says, a subsonic airfoil may be made to operate more efficiently at supersonic speeds than a supersonic airfoil.

The report suggests that further improvement might be possible. Since the low aspect ratio delta has a very rapid reduction of chord with span, an inverse thickness ratio—decreasing the percentage thickness of the root chord in comparison with tip chord percentage thicknesses—might add benefits.

Landing Speeds

Tests of models with a convex delta and using the special high lift device have indicated sufficient stability and lift generation to make possible landing speeds of perhaps 100 kt. for the supersonic transport design. This might eliminate one potential problem of the supersonic transport in that today's airports could not cope with it.

Gluhareff is the designer of the Sikorsky flying boats that began transoccan service in the 1930s—the S-40, S-42 and S-44.

preselect

the optimum jet flight path
quickly...accurately
with your

CRC MODEL 501 ANALOG FLIGHT PLAN COMPUTER

fits "instantaneous" analog computation to your present flight-planning techniques

To find out more about how the CRC 501 can serve you, write for Bulletin 501.

Your flight analysts have been planned into the CRC 501 Flight Computation System to conserve and use their experience and judgment, and thereby to make great savings in equipment and computing time. With the CRC system in use in your operations headquarters, your analysts program the information into the computer. Data required is determined by the computer, and is entered during the computation as needed. There is no need to program unnecessary information.

Greater computation speeds and accuracies create immediate operations economies and therefore higher profits.

You cannot sort out the thousands of flight path variables as swiftly and economically with any other system.

CRC

COLORADO RESEARCH Corporation

BROOMFIELD HEIGHTS, COLORADO

A SUBSIDIARY OF CARRIER CORPORATION

SAAB S29C photo-reconnaissance aircraft flies over rugged mountains north of Arctic Circle near Norwegian border of Sweden.

Swedish Air Defense, Part II

Sweden Tests Cold Weather Operation at

By David A. Anderton

Air Base F21, Sweden—This sub-Arctic base is a strong bastion, designed to defend northern Sweden and unintentionally protecting NATO's northern flank.

Its geographic position near Lulea makes it the natural center for a complex of military bases aimed at stopping air or ground drives against the rich natural resources and heavy industries of northern Sweden.

Although not a NATO country, neutral Sweden stands geographically in the way of any Russian drive against the northern NATO countries of Denmark and Norway. The only way there is, is through or over Sweden, and the Swedes have served notice that they know it and that they would fight. The fight would start from here.

F21 is both a unit and an air base designation. It is headquarters for Eskader 4 (4th Group) which includes the 21st Air Base Wing (Kungl. Norrbottens Flygbaskar), 11th Reconnaissance Wing, and 4th and 15th Day Fighter Wing. Base commander at F21, Col. B. Bellander, is also deputy chief of Eskader 4.

As the farthest-north permanent base in Sweden, F21 is a center of winter cold-weather operational experience. This experience is passed along to the other units of the Royal Swedish Air Force in two ways:

• **By the winter test** establishment, which puts new aircraft and equipment through their technical and operational paces in cold weather and feeds this information back to designers, pilots and ground crews.

• **By stationing other squadrons** here on temporary duty for a month at a time during the year to absorb a refresher course in Arctic operations.

As a winter base, F21 is typical of the North. From October through May, heavy snowfalls blanket the area with two or three feet of snow per storm. Continuous snow-clearing is the rule, and plows and blowers work around the clock.

Long Arctic Night

F21 has other advantages that make it an unusual operational training station. During the "long night" of the Arctic winters, the sun rises sometime around 11 a.m. and sets sometime after 2 p.m. The rest of the day is dark, and squadrons go on night-flying missions during what would otherwise be daylight hours. This is one of the few bases where a pilot can get up at a respectable hour in the morning, have a leisurely breakfast and then complete a night-flying exercise before lunch.

Lulea stands on sandy soil at the top of the Bothnian Gulf between Sweden and Finland, and the winds roar up the gulf carrying bad weather. At one time they carried along a complete sandstorm, and F21 is the farthest-north and only RSAF base to have suffered through one of the hazards of equatorial desert operations (AW Mar. 9, p. 307).

Work of the winter test unit is phased in early in the development program of any new airplane or piece of equipment. Preproduction planes fresh from early positions on the line at Saab Aircraft Co. are flown north for their first baptism of the snow in which they will spend a large part of their useful life.

Here the planes are flown hard by experienced test pilots in what would correspond to operational suitability trials in the USAF. Planes are flown in the patterns of operational sorties, on standard mission profiles to determine their toughness in a wintertime of simulated wartime.

Weapons are fired, communications and navigation gear checked, equipment inspected for any of the flaws that could cause trouble in cold-weather operations. Planes are cold-soaked, left out in the line in sub-zero weather, and then fired up and flown. A few weeks of this quickly shows whether or not the plane will ever take the rigors of the frozen north.

This program continues through the useful life of the airplane. At the time of AVIATION WEEK's visit, the latest modification of the Saab Draken—area-ruled and with a whacking big afterburner—was going through another routine series of checks. It has been through the Arctic mill before in prototype form, but

ROYAL SWEDISH AIR FORCE S29Cs are between missions at Air Base F21, headquarters for RSAF winter test establishment.

Northern Base

there had been enough changes made in equipment and the airplane itself to warrant another go-around. Said the pilot, just before taking off, "No trouble. This is a fine airplane," and then a hydraulic fuse failed in the system and delayed his takeoff. It always happens when there are vistors.

Operational activity at F21 centers on the mission of the unit, which is photo-reconnaissance. Equipment is Saab S29C Flying Barrels, a modification of the standard interceptor now operational with the RSAF. The S29C carries as many as six different camera installations and has modernized avionic equipment for better navigation.

It is a subsonic airplane, in fact the first sweptwing fighter to go into production in Europe, so it's getting a little old for the job. Its replacement is the Saab S32C, a photo-reconnaissance modification of the A32 Lansen attack aircraft, now being delivered to the Royal Swedish Air Force.

Normal camera installations include a pair of vertical mapping cameras, a pair of oblique survey cameras mounted one on each side, and a pair of low-altitude cameras, with 30-in. and 36-in. lenses for ground-hugging work.

During our visit, two pilot officers were briefed on a routine photo-reconnaissance mission to demonstrate the type of work done and their effectiveness in doing it. Briefings were in English.

The weather was not kind. A secondary cold front was moving eastward at about 32 kt., carrying snow showers with it. Low altitude wind was northwest and strong and there was a heavy turbulence below 3,280 ft. Upper-altitude winds were southwest, with jet stream speeds up to 80 kt. Contrails began at 26,200 ft. Weather at F21 was cloudy with 1,970 ft. base, visibility 1.9 to 3.1 mi.

One set of runway lights was not operational, but otherwise the standard radio and navigation aids were in order. This was the environment.

First mission was a single-plane low-level photography job on a reported

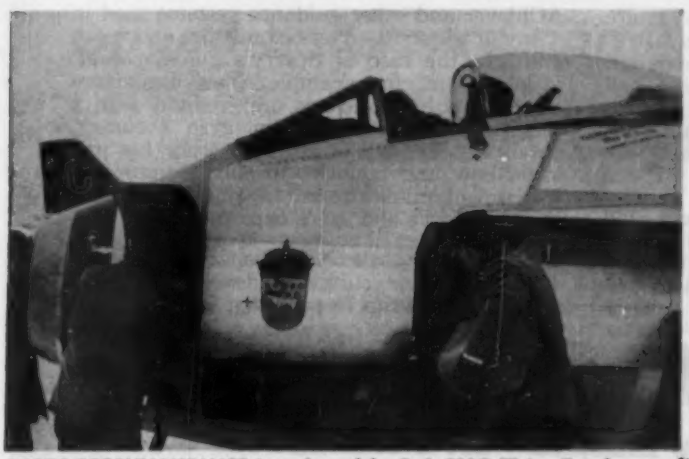


PHOTO-RECONNAISSANCE is performed by Saab S29C Flying Barrels, a modification of RSAF standard operational interceptor. Technicians pull film rolls from cameras after plane returns from mission (left). Low-level camera has telephoto lens, shoots forward and downward at a slight angle. Section of inlet cowl forward of camera (right) retracts for photography, is normally flush during mission.

Comparator measures dimensions to one-millionth of an inch. One of many pieces of ultra-precision equipment in the New Departure instrument/miniature ball bearing laboratories.

In many bearings, various dimensions and surface finishes must be held to within tolerances of one millionth of an inch.

Instrument Ball Bearings Help Missiles Along A Bright Path Of Precision!

CUSTOMER PROBLEM:

Missile guidance system manufacturers require a dependable source for super precise instrument ball bearings. When used in spin axis and gimbal applications, for example, these ball bearings help restrict vitally important drift, through extremely close tolerances and high precision uniformity.

SOLUTION:

New Departure research, development and production facilities were applied to solving the vital problem. Visual evidence of New Departure's success is the bright path of precision written across the skies by Sperry, AChiever and other guidance systems used in many of the most advanced missiles and space craft. In the case of Sperry's gyrosyn guidance system, for example, New Departure instrument ball bearings are credited with a remarkable 1200% gain in gyro accuracy. Proof enough that New Departure has the know-how and facilities to solve tomorrow's instrument/miniature ball bearing design problems in missile and space exploration.

What's more, these New Departure facilities are available for *your* design development right now! Call or write Department G-5.

NEW DEPARTURE

DIVISION OF GENERAL MOTORS, BRISTOL, CONN.

NOTHING ROLLS LIKE A BALL

FILM is taken from cassettes in portable darkroom on flight line, packed in containers, and delivered to the photo laboratory by motorcycle courier. Note ski-skid arrangement on motorcycle for winter operations on ice and snow-covered roads.

"enemy" radar station, actually one of the Swedish radio transmitters in a tough location to spot. The pilot was told to make his run in as low as possible, to go over the target at low altitude and return over a check point identified by grid coordinates. Takeoff time was 1000 hr., estimated time of arrival was 1045 hr. His aircraft was Red Charlie, said the briefing officer, reverting to the old phonetic alphabet, and cameras were to be fitted for low altitude.

The second pilot was asked to determine if there were "enemy" aircraft at a grid point and if so, what type. The target in reality was one of the satellite bases of F21. The run-in was to be at minimum altitude to a check point, followed by an accelerated fast climb over the target. Photos were to be taken with vertical cameras.

Alternate Mission

If the weather was impossible and the pilot could not make a high-level run, he was to make a low-altitude dash and use his nose cameras. Altitude choice depended on the weather. The return flight was to be over a check point and at minimum altitude. Takeoff and landing times were the same as for the first mission, and the aircraft was Red Bravo.

Both planes scrambled together on time and we waited for their arrival. Estimated times of arrival were good, and both planes were in the pattern on time. They had hardly stopped taxiing before the ground crews were unbuttoning the camera hatches and hauling out the film cassettes. Planes were met by a mobile dark room, where a technician transferred the exposed film to special containers, and where he would reload the cassettes during maximum effort missions.

PILOT completes shutdown while rolls of film are being removed after mission.

The containers were taken by motorcycle from the line to the photo laboratories and the pilots went for debriefing

New "Wings" for North Central!
NORTH CENTRAL
Speed and extra comfort on the new...
luxurious Super Northliner flights
CONVAIR
Swift, smooth, radar-equipped Convair Super-Northliners joined the Northliner fleet in daily service between key North Central route cities on April 26 : . . the latest advance in the continuing progress of North Central — America's leading local airline — first in its class in passengers, air mail and air express.
Progressive route expansions have extended North Central's system to approximately 5000 route miles — with fast, frequent, dependable service to 65 key cities, and their hundreds of adjacent communities in a nine state area.
NORTH CENTRAL AIRLINES
Serving 65 key cities in 9 states: Minnesota • Michigan • South Dakota
Iowa • Nebraska • Wisconsin • Illinois • North Dakota • Indiana

New from Honeywell: a high-performance miniature gyro with input freedom of ±60 degrees

Advanced design of the Wide-Angle MIG allows you to program missile flight while cutting size and weight of missile guidance system by more than 50 per cent.

HONEYWELL's leadership in gyro design is proved again. The new Wide-Angle MIG is a miniature integrating gyro with such a wide range of input angular freedom that it can be moved about its input axis up to ± 60 degrees without loss of space orientation.

At the same time this new gyro retains all the accuracy and extremely high performance characteristics of Honeywell's famous MIG family.

A floated gyro, the Wide-Angle MIG employs a damping technique that represents a distinct advance in the state of the art. It's the perfection of this technique that makes possible a gyro combining great input freedom with high accuracy.

Honeywell's Wide-Angle MIG offers advantages across many applications.

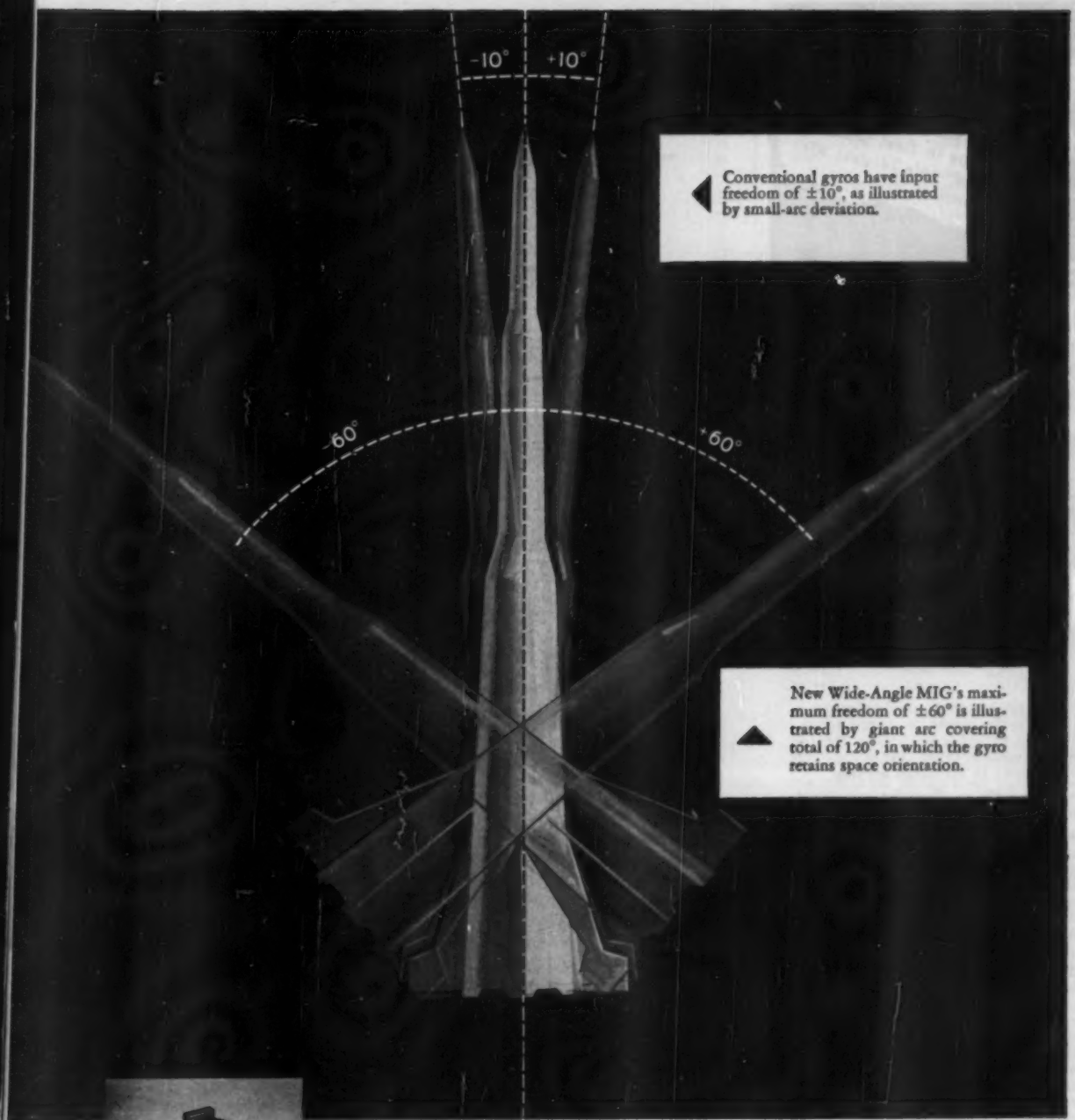
It is the most accurate miniature floated gyro available for radar systems that warn of distant ballistic missiles. Locked into the radar, it is capable of measuring a rate of movement as low as 10^{-6} radians per second—far superior to the rate gyros which are normally used in such applications.

In fact, the new gyro provides unusual benefits in any application that requires small size and weight, high accuracy and great input freedom. It is designed for both analog and digital rebalance systems and has other features which include increased torquing rates (to 80,000° per hour) and tolerance of ambient temperatures to 500°.

For complete information on Honeywell's new Wide-Angle Miniature Integrating Gyros, call or write Honeywell Aero, 2600 Ridgway Road, Minneapolis 13, Minnesota.

WIDE-ANGLE MIGS BY HONEYWELL

GG107 gyro for digital systems
GG90 gyro offers 60° input freedom
GG87 gyro has extremely low drift rate (exact rate classified)
GG83 gyro operates in ambient temperatures of 500°F.


-10°
+10°
Conventional gyros have input freedom of ±10°, as illustrated by small-arc deviation.
-60°
+60°
New Wide-Angle MIG's maximum freedom of ±60° is illustrated by giant arc covering total of 120°, in which the gyro retains space orientation.

Wide-Angle MIG illustrated occupies less than eight cubic inches, weighs less than one pound. It's part of Honeywell's complete line of 24 floated and two-axis gyros for all high-performance aircraft and missile requirements.

Honeywell

H Military Products Group

WASHINGTON, D.C.—Air freight ton miles reported to the Civil Aeronautics Board for 1958 show The Flying Tiger Line in first position as the nation's largest air freight carrier.

FLYING TIGER LINE

In 1958, The Flying Tiger Line flew 104 million ton miles of air freight on its domestic air freight and overseas contract air system.

This was the first time that any U.S. airline flew over 100 million ton miles.

SHIP WITH THE LEADER

IT COSTS NO MORE THAN ORDINARY AIR FREIGHT

You may have seen this slogan in Flying Tiger advertising. Its meaning is reflected in the 1958 traffic figures.

The figures, we believe, are the result of these – among other – facts:

• Our Lockheed Super-H Constellations are the largest, fastest commercial air freighters. In the United States, only Flying Tiger can give you Super-H all-cargo service.

• Flying Tiger offers the only coast-to-coast non-stop all-cargo flights.

• Ours is the only scheduled transcontinental air cargo service by an airline *specializing* in air freight. Our men and women, as air freight specialists, *should* do the best job of flying freight. We think the figures prove they do.

• More air cargo lift. Anyone can fly a few parcels. But when there's lots of freight, and big freight, capacity counts. The Super-H can carry nearly 50% more payload than any other commercial air-freighter. This greater capacity means greater ability to handle your shipments during heavy volume periods when planes with little cargo capacity soon fill.

These and many other factors enable Flying Tiger to tailor service to the specific needs of virtually any shipper. New features, recently announced, make Flying Tiger service more economical than ever. There are Flying Tiger offices in most principal cities. Phone now for complete rate and schedule data.

FLYING TIGER LINE

General Offices:
Lockheed Air Terminal
Burbank, California
Cable: Flytiger

JATO Boosts C-130B in Propeller Stress Test

Lockheed C-130B takes off assisted by eight JATO bottles during propeller stress tests at Eglin AFB, Fla. Gross weight is 135,000 lb.—almost maximum. Ground run was 2,300 ft. from point of engine runup. C-130B made first flight in December (AW Dec. 22, p. 63).

and a well-deserved sauna. There had been plenty of turbulence and they were tired from flying on the deck through continually rough air.

Mission Results

Both strikes were successful. Within one hour after the planes returned we were looking at yards of wet negatives and seeing the tiny mast of the "radar" station almost lost among towering trees but dead center on the frame. On the large rolls from the vertical cameras we could see the runway, taxiways and dispersal points where "enemy" interceptors stood at the satellite base.

"There were two things wrong," said the briefing squadron leader. "First, they used too much film—because they wanted to make sure of their target—and second, we should have had these negatives within 30 minutes."

(A concluding article on Swedish air defense will appear in next week's Aviation Week.)

PRODUCTION BRIEFING

Fairchild Camera and Instrument Corp., Syosset, N. Y., will produce two types of aerial reconnaissance cameras under Air Materiel Command contracts totaling $4,042,303. Cameras are the CAX-12, 70 mm. precision day reconnaissance camera and the K-47 night reconnaissance camera which uses flash bomb for illumination.

American Machine & Foundry Co., Engineering Division, Greenwich, Conn., will develop the ground installation of the guidance antenna for the Titan ICBM under $3.83 million contract from Bell Telephone Laboratories. AMF will design the hardened antenna storage and elevating equipment for the guidance system.

ACF Industries, Inc., American Car and Foundry Division, Berwick, Pa., will continue production of Snark missile launchers under $2.25 million follow-on contract from the Northrop Corp. The 16-wheeled launcher carries and erects the missile.

C. Itoh & Co., Ltd., Tokyo, will represent Ryan Aeronautical Co. in promoting sales of Firebee jet target drones in Japan. One year agreement gives Itoh rights to solicit sales, while Ryan reserves the right of acceptance or rejection.

Air Cruisers, Bel Mar, N. J., division of The Garrett Corp., will deliver 126 25-man life rafts to Trans World Airlines for use on overwater flights of the airline's jet aircraft.

Greer Hydraulics, Inc., Jamaica, N. Y., will distribute the Air Partner jet starting equipment in the United States under license from Atlas Copco A.B., Stockholm, Sweden. Air Partner is a rotary screw type air compressor suitable for jet starting, air conditioning and de-icing.

General Acoustics Corp. of Los Angeles Corp. has been formed to design and develop aircraft, missile and industrial noise suppression products.

Army Contracts

Following is a list of unclassified contracts for $25,000 and over as released by U. S. Army contracting offices:

U. S. ARMY ORDNANCE DISTRICT, Philadelphia, 128 North Broad Street, Philadelphia 2, Pa.

Brown Instrument Division, Minneapolis-Honeywell Regulator Co., Philadelphia, Pa., modification of government-owned Brown Instrument Electronic Strip Chart Recorders, DA-36-034-ORD-2689, $36,070.

Aircraft Armaments, Inc., Cockeysville, Md., thruster, cartridge actuated, T-25. DA-36-034-ORD-2859, $52,125.

Western Electric Corp., New York, Nike spare parts and components, DA-36-034-ORD-2228, $109,200; Nike spare parts and components, DA-36-034-ORD-2228, $66,600.

General Electric Co., Philadelphia, Pa., production of films in connection with Phase II, Little John rocket program, DA-36-034-ORD-2895, $89,386.

Frisz Instrument Division, Bendix Aviation Corp., Towson, Baltimore, Md., design, development and fabrication of a preset baroswitch project TN2-8109, DA-36-034-ORD-2890-RD, $99,741.

Western Electric Co., New York, Nike spare parts and components, DA-36-034-ORD-2228, $31,962; Nike spare parts and components, DA-36-034-ORD-2228, $48,960.

Remington Rand Univac Division, Sperry-Rand Corp., Philadelphia, Pa., design study of an electrical digital computer, BA-36-034-ORD-2872-RD, $28,527.

North Carolina State College of Agriculture of the University of North Carolina, Raleigh, N. C., study of motion of spin-stabilized rockets during burning, determination of launch parameters and development of instrumentation for the determination of experimental data and to simplify analysis of this data, DA-01-021-ORD-4592 and DA-36-034-509-ORD-35-RD, $73,500.

Western Electric Co., Inc., New York, Nike spare parts and components, DA-36-034-ORD-2228, $45,120; Nike spare parts and components, DA-36-034-ORD-2228, $147,608; Nike spare parts and components, DA-36-034-ORD-2228, $44,640; Nike spare parts and components, DA-36-034-ORD-2228, $138,676.

Western Electric Co., Inc., New York, Nike spare parts and components, DA-36-034-ORD-2388, $18,519; Nike spare parts and components, DA-36-034-ORD-2388, $41,257; Nike spare parts and components, DA-36-034-ORD-2388, $48,802.

Electron Tube Division, Radio Corporation of America, Lancaster, Pa., study of "Solid State Image Intensifier for Industrial Application", DA-36-034-ORD-2856, $24,000.

Western Electric Co., Inc., New York, the following contracts are for Nike spare parts and components and appear under contract number DA-36-034-ORD-2228: $171,700; $989,200; $159,151; $191,270; $104,340; $170,520; $160,200.

Western Electric Co., Inc., New York, Nike spare parts and components, DA-36-034-ORD-2228, $36,699.

Western Electric Co., Inc., New York, Nike spare parts and components, DA-36-034-ORD-2228, $100,023 and Nike spare parts and components, DA-36-034-ORD-2228, $20,577.

Western Electric Co., Inc., New York, Nike spare parts and components, DA-36-034-$78,496: (4) $124,146.

Douglas Aircraft Co., Inc., Santa Monica, Calif., Blue Streak and emergency spare parts, $138,433, and Blue Streak and emergency spare parts, DA-36-034-ORD-2582, $116,353.

U. S. ARMY ENGINEER DISTRICT, Omaha, Corps of Engineers, 1709 Jackson Street, Omaha, Neb.

Olson Construction Co., Lincoln, Neb., construction of shop, A/C engine inspection and repair, Lincoln AFB, Neb., Contract No. DA-25-066-ENG-5515(IFB ENG-25-066-59-86), $269,996.

Peter Kiewit Sons' Co., Omaha, Neb., construction of extension of road, Offutt AFB, Neb., Contract No. DA-25-066-ENG-5519(IFB ENG-25-066-59-41), $209,376.

Kingery Construction Co., Lincoln, Neb., construction of readiness crew building, Lincoln AFB, Neb., Contract No. DA-25-066-ENG-5513(IFB ENG-25-066-59-92), $617,584.

Gunnar I. Johnson & Son Co., Minneapolis, Minn., construction of dormitories, shop and fuel storage, Grand Forks AFB, N. D., Contract No. DA-25-066-ENG-5518(IFB ENG-25-066-59-77), $957,922.

Megarry Brothers, St. Cloud, Minn., construction of alert apron, blast pavement, perimeter facilities and bridge, Grand Forks AFB, N. Dak., Contract No. DA-25-066-ENG-5514(IFB ENG-25-066-59-79), $979,955.

BOSTON ORDNANCE DISTRICT, Army Base, Boston 10, Mass.

Avco Manufacturing Corp., Everett, Mass., research in re-entry physics, Contract No. DA-19-020-ORD-4862, $984,000.

Raytheon Manufacturing Co., Andover, Mass., electronic components, Hawk missile, Contract No. DA-19-020-ORD-4777, 18 line items, $32,285.

Raytheon Manufacturing Co., Andover, Mass., electronic components, Hawk missile, Contract No. DA-19-020-ORD-4777, 8 line items, $30,326.

U. S. ARMY ENGINEER DISTRICT, Pittsburgh, 925 New Federal Building, Pittsburgh, Pa.

Malan Construction Corp., New York, construction of missile master facilities, phase I and II, Pittsburgh Defense Area, Collier Township, Allegheny County, Pa., IFB ENG-36-058-59-20, $2,715,237.

U. S. ARMY ORDNANCE DISTRICT, Los Angeles, 55 South Grand Avenue, Pasadena, Calif.

Firestone Tire & Rubber Co., Los Angeles, guided missile artillery, $5,044,080.

North American Aviation, Inc., Canoga

SERVICE IS OUR BUSINESS — and we conduct it in one of the world's finest facilities for the repair, maintenance and overhaul of aircraft superchargers, turbines and compressors.

CHECKLIST FOR SUPERIOR SERVICE

✔ FACILITIES

A new, functionally designed modern plant. Air-conditioned, dust-free, humidity-controlled laboratory areas. Fully equipped to provide complete single source service, from disassembly and cleaning operations to final system testing.

✔ EXPERIENCED PERSONNEL

Highly skilled engineers and technicians, each a specialist at his job, with an average of 18 years of invaluable experience on cabin superchargers, compressors and other related aircraft components. All key personnel are CAA certificated.

✔ REPUTATION

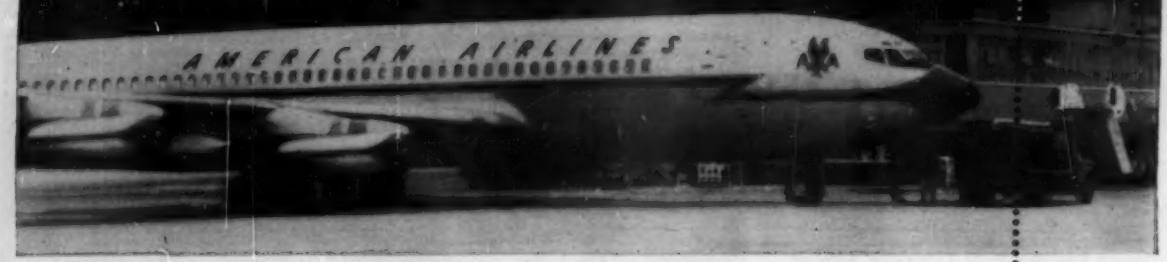
Perhaps the most important factor is Aircraft Turbine Service's outstanding reputation, earned by *superior* performance during years of service to leading airlines, the Military Air Forces and corporate aircraft operators.

Aircraft Turbine Service, Inc.

1300 Shames Drive
Westbury, L. I., N. Y.
EDgewood 3-1300

HOBART GROUND POWER UNITS

...always on the job, are indispensable to the men charged with the responsibility of maintaining aircraft while on the ground.



* The energy center for this fuel-to-power-to-airplane is a HOBART truck mounted Diesel 400 cycle generator—American Airlines' choice for ground power support of their Boeing 707 and Lockheed Electra Aircraft.

It supplies electrical power for ground operation of cabin air conditioning or heating, and lighting; provides ground check of communication, control and hydraulic systems, and electrical and electronic gear.

*

Whether you are using turbo-jet, turboprop or reciprocating engine powered aircraft, dependability of your ground power equipment is of vital importance. That's why the majority of the air lines all over the world use Hobart.

LOOK TO HOBART

. . . for a realistic approach to your ground power requirements!

PRACTICAL KNOWLEDGE of ground power problems and trends through close coordination with air line personnel.

CONTINUING INVESTIGATION and evaluation of air lines' needs to improve quality and performance in ground power equipment.

ENGINEERING ASSISTANCE in selection and use of right ground power equipment to meet your special requirements.

RESULT—An economical solution to your many and varied application problems.

☑ CHECK HOBART'S PERFORMANCE, *specifications and price before you buy! Write today for complete details.*

MOTOR GENERATOR CORPORATION *(Hobart Brothers Affiliate)*

BOX AV-59, TROY, OHIO

Park, Calif., rocket engines, $2,645,000.

Motorola, Inc., Phoenix, Ariz., telemetry sets, $101,507.

Solar Aircraft Co., San Diego, Calif., study, $197,000.

Douglas Aircraft Co., Inc., Santa Monica, Calif., supplies and services, $40,000.

Douglas Aircraft Co., Inc., launching area items, $690,000 and repair parts, $397,800.

Missile Development Division, North American Aviation, Inc., Downey, Calif., study of hypervelocity impact, $47,972.

North American Aviation, Inc., Canoga Park, Calif., design and development, $160,000.

North American Aviation, Inc., Canoga Park, Calif., rocket engines, $112,500.

Missile Air Division, United States Chemical Milling, Manhattan Beach, Calif., bulkheads, $44,468.

Firestone Tire & Rubber Co., Los Angeles, Calif., repair parts, $91,650.

Gilfillan Bros., Inc., Los Angeles, Calif., repair parts, (1) $59,517; (2) $31,128; (3) $78,496; (4) $124,146.

Firestone Tire & Rubber Co., Los Angeles, Calif., spare parts, $52,000.

USAF Contracts

Following is a list of unclassified contracts for $25,000 and over as released by U.S. Air Force contracting offices:

HEADQUARTERS, AIR FORCE OFFICE OF SCIENTIFIC RESEARCH AIR RESEARCH AND DEVELOPMENT COMMAND, Washington 25, D. C.

Baylor University, Houston, Texas, continuation of research on "Investigation of the Effect and the Mode of Action of the Psycho-Chemicals on Human State of Consciousness," (AF10(603)-79), $38,674.

Massachusetts Institute of Technology, Cambridge, Mass., continuation of research on "Neutron Diffraction Studies of Solids," (AF18(603)-84), $91,950.

New York University, New York, continuation of research on "Ignition and Combustion of Organo-Metallic Compounds," (AF49(638)-173), $75,000.

Carnegie Institute of Technology, Pittsburgh, Pa., continuation of research on "Conformal and Variational Methods," (AF49(638)-372), $24,358.

Washington University, St. Louis, Mo., continuation of research on "Paramagnetic Resonance of Free Radicals," (AF49(638)-464), $75,000.

Republic Aviation Corp., Farmingdale, L. I., N. Y., research on "Electromagnetically Induced Chemical Reaction," (AF49(638)-552), $63,982.

The Regents of the University of Minnesota, Minneapolis, Minn., research on "Theoretical and Experimental Studies of Mass Transfer for Cooling," (AF49(638)-558), $118,994.

President and Fellows of Harvard University, Cambridge, Mass., "Theoretical Studies of the Interactions of Fields and Particals," (AF49(638)-589), $74,395.

Texas A & M Research Foundation, College Station, Texas, study of "Electronic Absorption Spectra of Simple Molecules," (AF49(638)-593), $38,335.

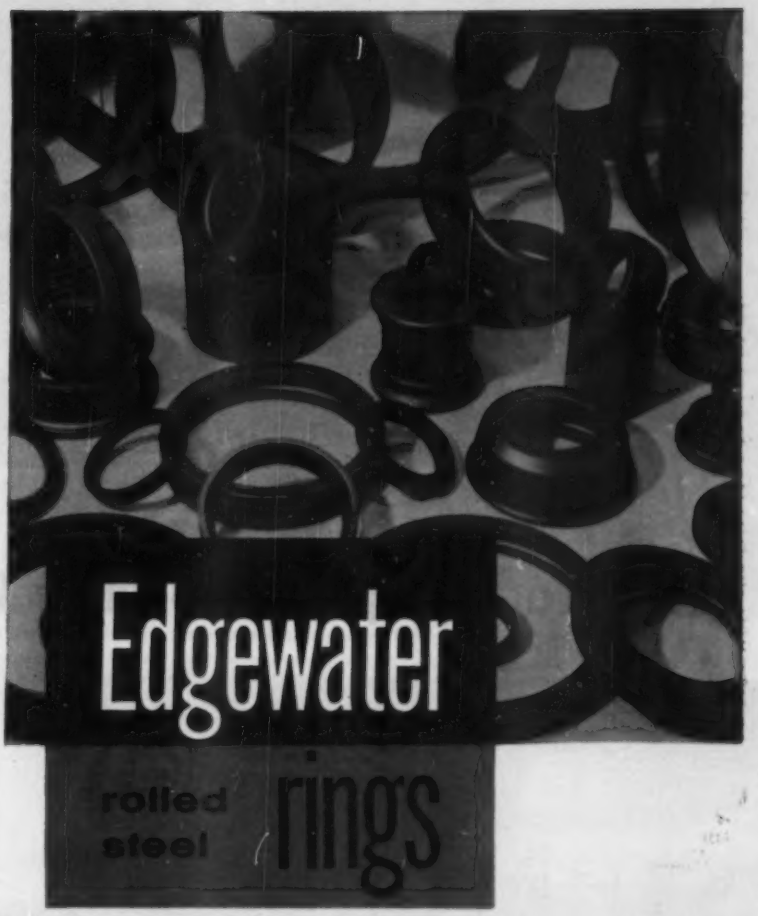
University of Maryland, College Park, Md., continuation of "Theoretical Research Program in Statistical Mechanics and Chemical Physics," (AF118(600)-1315), $107,169.

The Pennsylvania State University, University Park, Pa., continuation of research on "The Crystal-Structural Bases for Some Physical Properties of Crystalline Solids," (AF18(603-35), $114,968.

The Catholic University of America, Washington, D. C., continuation of research on "Irreversible Thermodynamics," (AF49(638)-452), $37,881.

Plasmadyne Corp., Santa Ana, Calif., continuation of research on "Acceleration and Channeling of Continuous Plasma Jets by Magnetic Fields," (AF49(638)-335), $82,354.

The Pennsylvania State University, University Park, Pa., "Field Emission Studies of Metal Surfaces," (AF49(638)-154), $77,641.



diameters 5 to 145 inches—accurate rolling reduces machining—simple or complex cross-sections—rolling gives strength, toughness

Rolled from solid blocks of steel, Edgewater Rings are strong and tough. Simple or complex cross-sections are formed to tolerances so close that only a minimum of machining is necessary. This means substantial savings in material and labor. Edgewater provides complete facilities for finishing and heat treatment, if required.

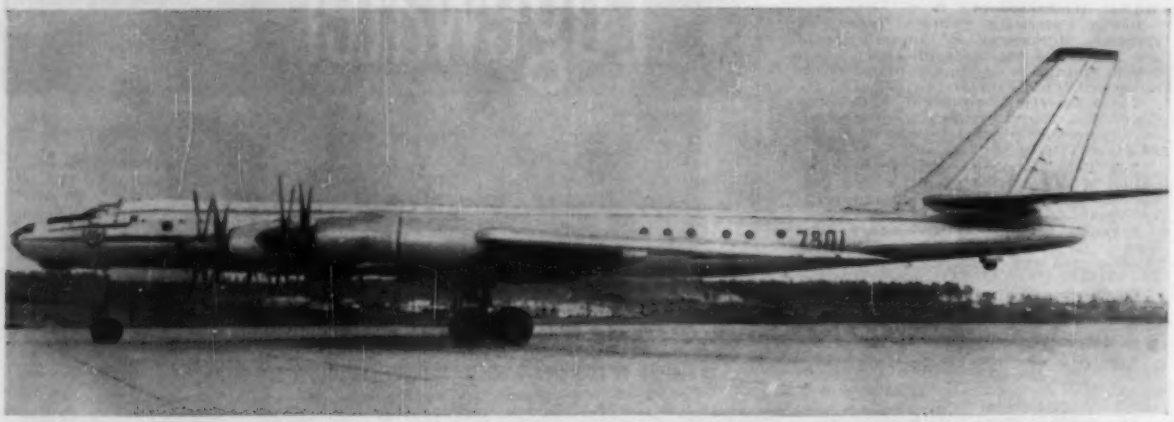
Write for descriptive illustrated bulletin.

Edgewater Steel Company

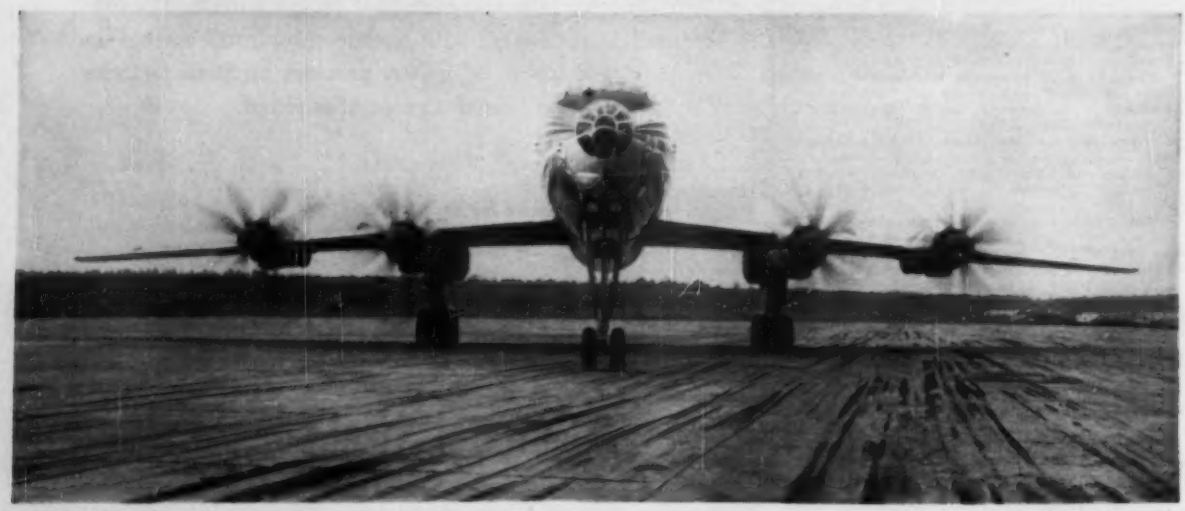
Dept. AW • P.O. Box 478 • Pittsburgh 30, Pa.

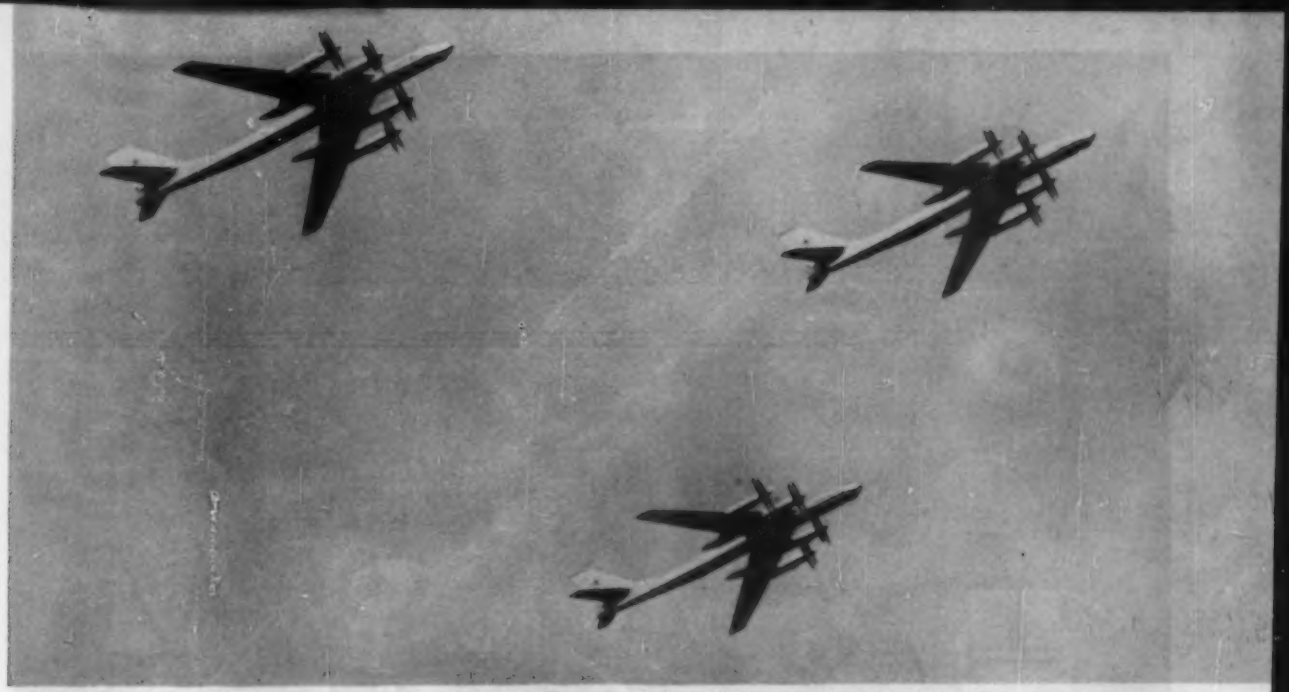
Soviet Tu-114 turboprop transport, shown at Moscow Airport, can fly nonstop from Moscow to New York with 120 passengers.

Tu-114 Turboprop, Bear Bomber Compared



Larger Tu-114D, civil version of the Tu-95 Bear turboprop bomber, has thinner fuselage than Tu-114. Aircraft is powered by four Kuznetsov NK-12 engines (AW Oct. 6, p. 36), producing 12,000 eshp. each. Sweep of wing is apparent in photo below.

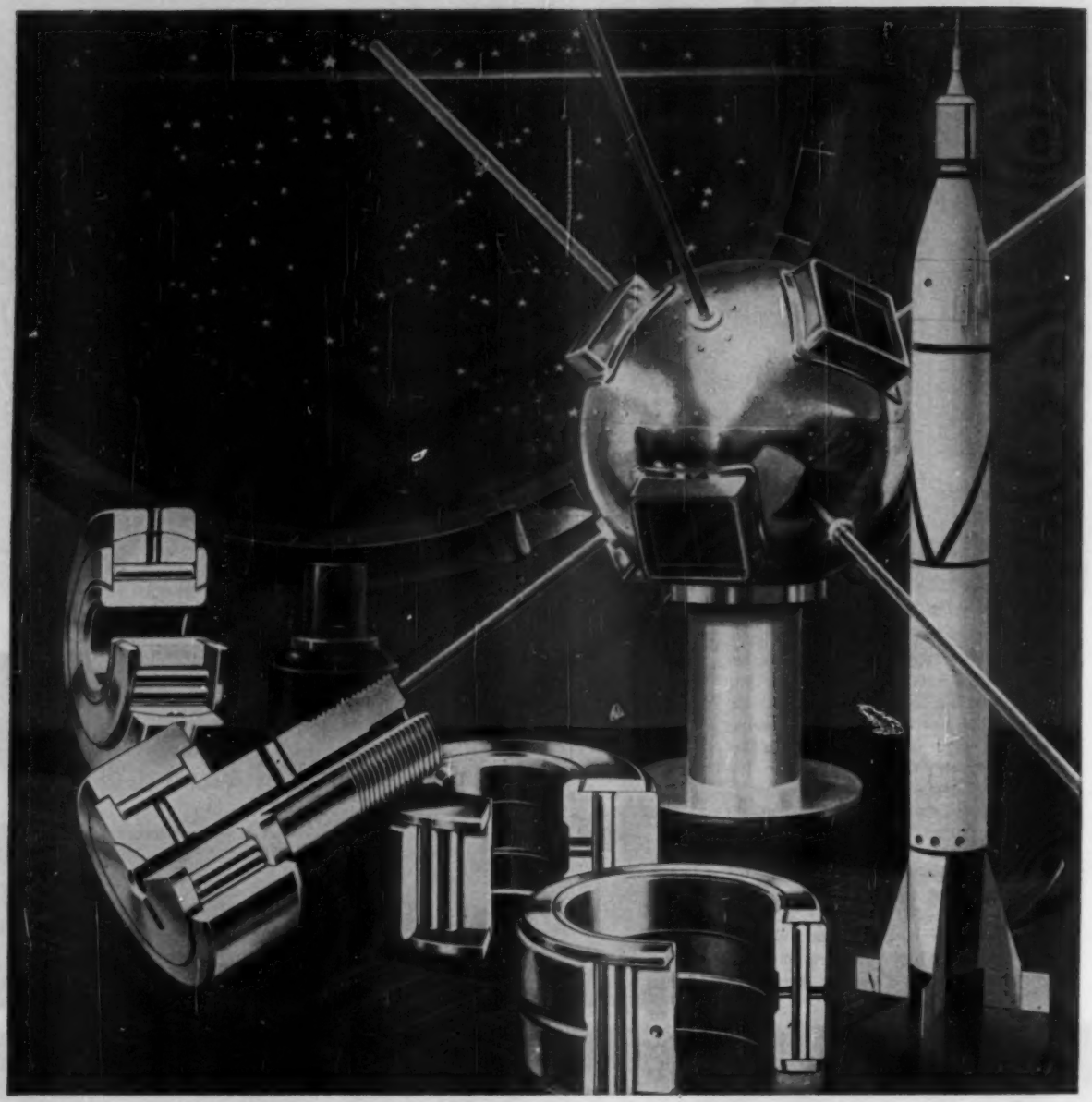




Flight view of Tu-114D emphasizes sweep-back of wing, which appears to be set higher than that of Tu-114. Note radome on nose.

Bear bomber (above, over Tushino) has range of about 8,000 mi. Wing aspect ratio is between that of Boeing B-47 and the B-52. Tu-114 civil version (right) is double-decked. Engines apparently have higher compression ratio than usual Russian turbine engines, probably good fuel consumption compared with Western turboprops.

Bear bomber (below) has a tail similar to the Bison and Badger. Bulges near the tail gun compartment are radomes; similar installations are on all Russian bombers. Wing is quite stiff, compared with Western planes. Skin does not wrinkle as much as U. S. planes, indicating use of a heavy skin.



ON THE MARK . . . WITH BEARINGS FOR MISSILES

The fantastic speeds of modern missiles call for virtually instantaneous response of systems for power generation, actuation and control.

This means friction must be reduced to a minimum within stringent limits of weight and space. Torrington has brought Needle Bearings to the mark of capacity, efficiency, precision and reliability that has won them a place in operational missiles today. Torrington has developed many types for highly specialized aircraft and missile applications.

Advances in propulsion and missile control bearings are another example of Torrington's continuing research to improve bearings in design, material and performance.

THE TORRINGTON COMPANY

Torrington, Conn. • South Bend 21, Ind.

Visit Torrington • Design Engineering Show • Philadelphia • May 25–28

RESEARCH FOR PROGRESS IN BEARING DESIGN AND PERFORMANCE

Nuclear Rockets May Operate by 1970

By Michael Yaffee

New York—Nuclear-powered rockets are almost certain to be flying major space missions by 1970, scientists working in the field believe. High specific impulse and sustained power capability give them a strong competitive edge on their chemical counterparts and, despite several important problems such as materials limitations that still have to be solved, assure them a significant role in future space exploration.

Consensus among a rapidly growing group of reputable scientists is that the first type of nuclear propulsion unit to see extensive service will be a comparatively unsophisticated, low-power heat transfer rocket in which the working fluid or propellant and the energy source are distinct.

In its simplest form this rocket will use a solid core fission reactor to heat a working fluid which will then be ejected through an expansion nozzle to produce thrust. Very likely it will be boosted off the launch pad by a large chemical rocket.

Early Stage

Actual United States nuclear rocket program, Project Rover, is still in an early development stage (AW Feb. 16, p. 48). Nevertheless, established propulsion scientists and engineers are now expressing unreserved confidence in the development and performance of nuclear rocket propulsion and, in technical society papers and official presentations before congressional committees, show a somewhat surprising amount of agreement in the pictures they draw of tomorrow's nuclear-powered space vehicles. Here, briefly, is how they collectively see the first nuclear rocket in design, operation and function:

For power it will use an open cycle, solid fuel core, fission reactor. Of all possible ways of using nuclear energy for rocket propulsion, this approach is presently the most advanced owing largely to the knowledge and experience gained from work on stationary atomic powerplants. Other methods—electromagnetic acceleration, radioactive isotope decay, fusion—are still in a comparatively early research stage and are not expected to find applications until somewhat later, despite recent major advances in the direct conversion of nuclear energy to electricity.

The reactor will be located in what would correspond to the combustion chamber of a chemical rocket. Core of the reactor will consist of fuel elements, control rods, moderators and reflectors. The core will be enclosed in a cylindrical pressure shell which will be attached to a regeneratively cooled De Laval rocket nozzle.

Fuel elements will be flat or slightly curved plates of uranium-235 and a non-fissionable, high-temperature structural material. Choice of the structural envelope for the uranium is still open to question. In a paper prepared for presentation before the House Committee on Science and Astronautics, W. J. Reinhardt, J. J. Newgard and Myron Levoy of Thiokol's Reaction Motors Division suggest graphite as a combination moderator and matrix for the uranium.

Frank Rom and Paul Johnson of the National Aeronautics and Space Administration' Lewis Research Center chose tungsten in their study of a space nuclear rocket engine which they described at the recent Society of Automotive Engineers National Aeronautics Meeting. Because natural tungsten competes with uranium for the neutrons generated in the reactor, Rom and Johnson propose to separate out and use only the tungsten-184 isotope which has a comparatively low neutron capture cross section.

As a moderator, Rom and Johnson favor the use of hot-pressed blocks of beryllium oxide. These units, whose sole purpose is to slow down fast neutrons, would be inserted between the fuel element plates. The reflector surrounding the fuel elements will be fabricated from beryllium or beryllium oxide.

Boron, which has a fairly high melting point and neutron absorbing capacity, will be used to control the reactor. (Other materials, such as the

MARS MISSIONS

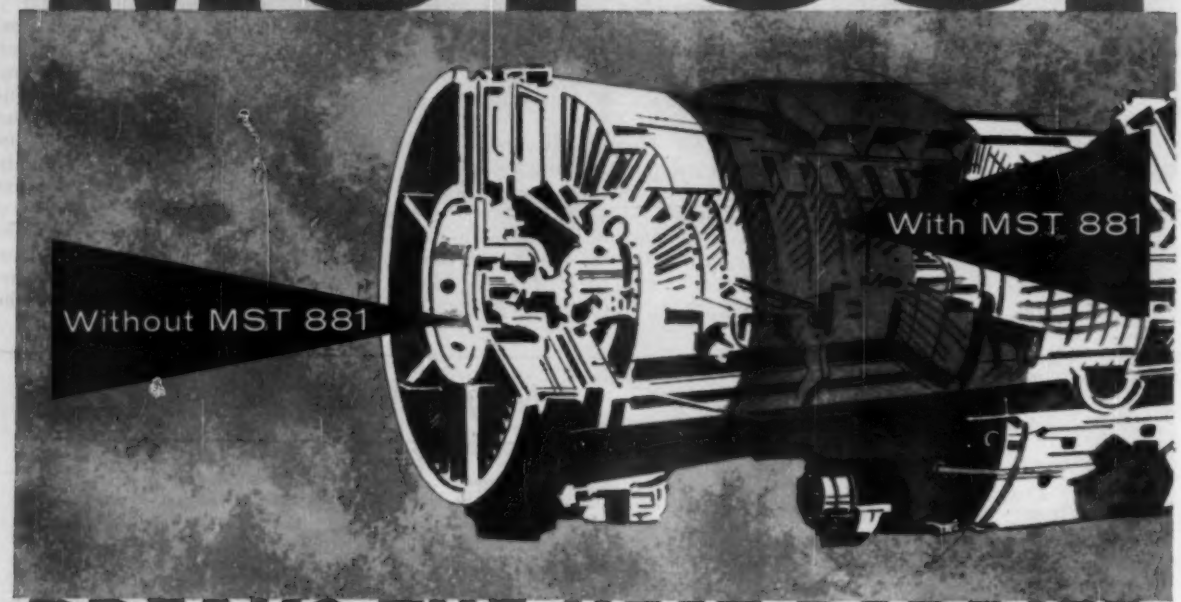
Mission	Required Velocity Increment (mi./sec)	Rocket Propulsion System	Operating Temperature	Specific Impulse, sec.	Payload lb.	Time days
Minimum energy round trip (initial weight in orbit, 25,000-lb. vehicle).	6.9	chemical	.....	400	1,800	973
		fission	4,500F	940	5,500	973
		fission	6,000F	1,330	9,300	973
		electric	.....	5,000	10,200	1,099
Extra energy round trip (initial weight in orbit, 100,000-lb. vehicle).	9	chemical	.....	400	0	.....
		fission	4,500F	940	1,100	508
		fission	6,000F	1,330	7,400	508
		electric	.....	5,000	27,800	803
Extra energy round trip, 30-day wait at Mars (initial weight in orbit, 500,000-lb. vehicle).	14	chemical	.....	400	0	.....
		fission	4,500F	940	7,500	570
		fission	6,000F	1,330	49,000	570
		electric	.....	5,000	0	.....

Table, prepared by NASA's Frank Rom and Paul Johnson, compares performance of three propulsion systems on three different round trip Mars' missions. Vehicles start from a 300-mi. altitude earth orbit, swing or orbit around Mars and then return to an earth orbit.

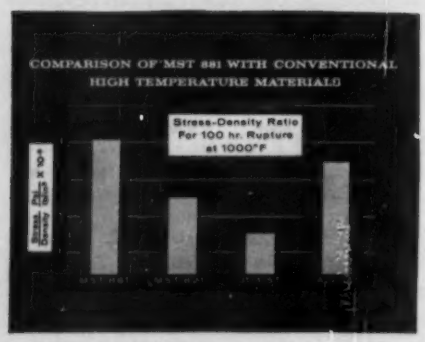
PROGRESS REPORT

New Mallory-Sharon 1100° Titanium Alloy

MST 881



BREAKS THE HEAT BARRIER



Note high stress/density ratio of MST 881 at 1000° F., compared to MST 821 alloy, 304 and A 286 stainless steels.

MST 881, the new high temperature titanium alloy recently announced by Mallory-Sharon, has been successfully forged on a production basis... meeting aircraft industry specifications. Leading manufacturers are now testing MST 881 for use in compressor shafts, wheels and blades in Mach 3 jet engines ... where prolonged high temperatures will be encountered.

Studies are also being carried out on application of MST 881 in the landing apparatus of manned skip-glide vehicles, in high temperature gears, machine gun poppet valves, and steam turbines operating at 1000° F.

MST 881 provides excellent long term strength characteristics at temperatures of 1100° F., and, for short periods, at temperatures as high as 1600° F. This new material offers promising application possibilities for missile, engine and airframe producers. Write today for Technical Data Sheet on MST 881.

MALLORY SHARON

MALLORY-SHARON METALS CORPORATION • NILES, OHIO

rare earth metal gadolinium which has 50 times the neutron absorbing capacity of boron, show promise but are expensive and still in a comparatively early stage of development.) Actual control will be effected by insertion of the boron into the core and close to the fissioning fuel elements.

Rom and Johnson suggest the use of control rods which can be inserted uniformly in the moderator regions. Small, solar-powered electric motors, located on a bulkhead in the pressure vessel, would drive the rods in and out. Reinhardt, Newgard and Levoy feel reflector control would prove more efficient, easier to use and cool, less likely to cause channel blockage, and would leave more room for fuel elements.

Curved stainless steel control plates containing boron would be dropped into curved slots machined out of the beryllium oxide reflector blocks. Passing through a series of blocks, each control plate would ride in a bearing race in the bottom block and would be rotated by a mechanical drive system. To slow the reactor down, the boron-faced plates will be turned in toward the reactor core, absorbing neutrons and preventing them from bouncing off the beryllium oxide reflector. Turning the plate out will permit more neutrons to hit the reflector, bounce back into the core—at a slower speed—and find an atom of uranium-235.

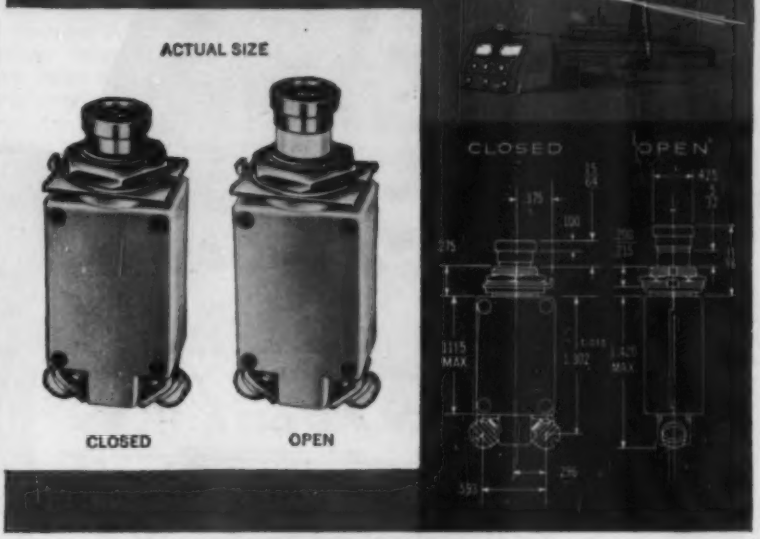
Hydrogen Coolant

Hydrogen's low molecular weight makes it the almost inevitable choice for working fluid and coolant, despite its extremely low boiling point and high combustibility. Stored as a liquid in an insulated tank and under pressure, hydrogen will be fed by a turbopump into the end of the rocket nozzle. Here, it will reverse its direction and flow forward through the walls of the nozzle and through passages in the reflector, where it will remove heat generated by neutrons and gamma radiation, and then into the plenum at the forward end of the reactor. At the plenum, some hydrogen will be diverted for further cooling of reactor components and for driving the turbopump. Exhaust from the turbine will be ejected through small thrust recovery nozzles.

Most of the hydrogen, however, passes from the plenum into the reactor, over the fuel elements where it picks up heat and out the expansion nozzle. To keep reactor weight low and at the same time include as much moderator material as possible, Rom and Johnson propose to make the total flow passage volume small, and suggest a flow area equal to 10% of the reactor core frontal area.

Though relatively simple, a core design based on a constant void fraction (flow area/total area) will result in a

Now Available...



THE NEW

KLIXON

Micro-Miniature Circuit Breaker for Aircraft, Radio and Electronic Equipment

These *Micro-Miniature* KLIXON D7274-1 Circuit Breakers set new standards in size, weight and performance. Their *fast tripping response* provides protection for low thermal mass components used in aircraft, radio and electronic gear.

Configurations are available for installation in existing panels that accommodate the NAF-1357 panel-mounted fuses or larger neck-mounted miniature circuit breakers. To give remote indications (light or buzzer), a normally open auxiliary circuit can be provided.

Compare these features . . .

- Weight 0.9 oz.
- Extremely simple trip-free design . . . no reset possible while button is depressed.
- Maximum operating force — open and reset 5 lbs.
- Minimum and maximum limits of ultimate trip (25°C) — 115% minimum, 150% maximum.
- Overload calibration — 200% trip limits 15 seconds maximum.
- Operating altitude — 80,000 ft.
- Voltage drop maximum — 1.50 volts.
- High rupture capacity — tests over 4000 amperes, 120 VAC.
- Ratings — ½ to 5 amperes.

Send for complete information on this new KLIXON *Micro-Miniature* Circuit Breaker, today.

METALS & CONTROLS CORPORATION
Spencer Division
2805 Forest St., Attleboro, Mass.
KLIXON®

Western Manufacturers — refer inquiries directly to Metals & Controls Corporation, Southern California Office . . . 232 North Lake Ave., Pasadena, Calif., Tel: Ryan 1-4288.

BOEING 707

CONVAIR 880

DOUGLAS DC8

LOCKHEED ELECTRA

Yes, from the standpoint of time, these jet-age transports by Boeing, Convair, Douglas and Lockheed are literally shrinking the world, while establishing higher standards of comfort, convenience and safety.

The world's airlines, working in close cooperation with these aircraft manufacturers and their suppliers, have made every effort to guarantee the ultimate in passenger conveniences. One of the outstanding features contributing to reduced groundtime is the use of Camloc quick operating fastening devices on doors and access panels . . . performance proved over millions of miles of aircraft service.

CAMLOC®

"Specialists in Fasteners for Industry"

CAMLOC FASTENER CORPORATION • 22 SPRING VALLEY RD., PARAMUS, N. J.
WEST COAST OFFICE: 5410 WILSHIRE BLVD., LOS ANGELES, CALIF. • SOUTH WEST OFFICE: 2509 W. BERRY ST., FORT WORTH, TEXAS

rapidly increasing pressure drop as the gas approaches the hot end of the reactor, particularly of void fraction, according to Reaction Motors Division's Reinhardt, Newgard and Levoy. A variable void fraction through the core (with the higher void fraction at the hot end) would reduce this pressure drop without much added fabrication difficulty. Also, they say, it might be possible to reduce the structural weight of the reactor core owing to lower coolant drag forces on the structures.

In a nuclear fission system such as the one described, it is estimated that the temperature of the gas as it leaves the De Laval nozzle will run 4,000 to 4,500F. Specific impulse of the system will probably be between 900 and 1,000F.

Most rocket engineers and scientists believe this system concept can be turned into a working reality within 10 years. It will take this long, many of them feel, to solve the important problems still blocking the way to a practical, lightweight, mobile reactor capable of powering a space vehicle. Among the most critical of these problems are the following:

• **Development and fabrication** of materials capable of withstanding 4,000-5,000F. Because specific impulse rises with temperature, even higher reactor temperatures are desired but not considered feasible. Highest melting point of any known material, a 4:1 mixture of tantalum carbide and hafnium carbide, is only about 6,900F. Preferably, these refractory materials should also be lightweight, but this too appears inconsonant.

• **Radiation resistance.** Scientists have already accomplished a great deal in the development of radiation resistant, high temperature hydraulic fluids, lubricants, electronic materials, sealants and so on but feel that much greater improvements are still required.

• **Reactor controls.** To prevent propellant waste, the reactor will have to be brought up to operating power in a matter of seconds. Controls will have to be developed that can do this and do it safely.

• **Shielding.** Heavy radiation shielding will be required to protect critical vehicle components and payload. Weight of the shielding will severely penalize vehicle performance and payload unless ways can be found to reduce the required amount of shielding or the weight of the shielding material. Separation of the reactor chamber from the rest of the vehicle offers a limited hope of relief here, as does shadow shielding.

• **Fission fragments.** Destruction of fuel elements during power operation may result in the formation of small radioactive fragments which could find their way out of the reactor and into the exhaust jet, causing contamination of the test stand and the adjacent areas.

• **Reactivity changes.** Destruction of core elements would also change void and solid volumes in the reactor and probably cause severe changes in the reaction rate.

• **Component development.** In addition to the problem of developing a mobile, efficient fission reactor, there are a number of smaller but still difficult problems involved in the development of the other essential components such as turbopumps and valves. The turbopump, for example, will be required to handle a cryogenic fluid in a hot, radioactive environment. The bypass valves which are used to control the turbine will have to stand up and react instantaneously and positively in regulating the flow of a 1,500F gas. Turbopump and valve controls will have to be tied in precisely to reactor control.

Solutions to some of these problems are already being formulated as a result of the nuclear rocket program, Project Rover, now under way at Los Alamos Scientific Laboratory. The Atomic Energy Commission's Aircraft Nuclear Propulsion project which is encountering many of the same problems is also supplying some answers (AW April 6, p. 87).

Air Force sponsored programs on the development of high temperature,

Future advancements in missile and space technology are largely dependent on activities today in operations research. At Lockheed, operations research scientists explore future programs, evaluate the objectives and requirements of new proposals, establish parameters for the most effective procedures, determine specifications, perform preliminary design and analysis and originate proposals for both immediate and long term development.

Scientists in this area must extrapolate from known scientific laws or engineering principles, new methods, techniques and applications as far as a decade or more away.

Studies include: game theory; linear programming; decision theory; statistics applications; logistics; cost analysis; industrial economics; electronic systems; operations engineering; military operations; development planning; and weapons systems operational analysis.

Scientists and engineers of outstanding talent and inquiring mind are invited to join us in the nation's most interesting and challenging basic research and development programs.

Write: Research and Development Staff, Dept. E-17, 962 W. El Camino Real, Sunnyvale, California. U.S. Citizenship required.

"The organization that contributed most in the past year to the advancement of the art of missiles and astronautics."
NATIONAL MISSILE INDUSTRY CONFERENCE AWARD

Lockheed / **MISSILE SYSTEMS DIVISION**

Weapons Systems Manager for the Navy POLARIS FBM;
DISCOVERER SATELLITE; Army KINGFISHER; Air Force Q-5 and X-7

SUNNYVALE, PALO ALTO, VAN NUYS, SANTA CRUZ, SANTA MARIA, CALIFORNIA
CAPE CANAVERAL, FLORIDA · ALAMOGORDO, NEW MEXICO · HAWAII

NORTRONICS UNIVERSAL DATICO SOLVING CHECKOUT PROBLEMS FOR ALL 3 SERVICES!

Positive proof that Datico is truly universal automatic checkout equipment: contracts for checkout requirements on missile systems and equipment in all three military branches of the Department of Defense.

ARMY – Nortronics is developing for the U.S. Army a set of Datico universal test equipment designed toward the test of seven different complete missile systems.

NAVY – An application of the Universal Datico is being developed for operational checkout of an advanced U.S. Navy missile system.

AIR FORCE – Universal Datico is at work today in a U.S. Air Force operational environment, operated by service personnel on a production-line checkout application to U.H.F. equipment.

Today's Universal Datico is available off-the-shelf: Federal Stock Catalog Number 6625-650-7542. It can be readily packaged for maximum mobility, and is applicable for use at launching sites, maintenance areas, depots, and assembly-line checkout stations.

Tomorrow's Datico is already in advanced development – by the same management-engineering team that delivered Datico in time for today's weapons. *For your systems checkout requirements at all test levels,* call Nortronics. Or, write: Chief Applications Engineer, Dept. 2003-D2, Nortronics, A Division of Northrop Corporation, 500 East Orangethorpe, Anaheim, California.

NORTRONICS *A Division of* **NORTHROP CORPORATION**

radiation resistant materials are making notable progress. Specific hardware such as turbopumps and propellant tanks are also under development. It is sufficient to say, Rocketdyne's chief engineer Thomas Dixon recently reported to the House Committee on Science and Astronautics, that required components can be provided by the time useful reactors are available.

The next questions—the two important ones that Congress is asking U. S. space scientists—are these: When nuclear rocket propulsion systems do become available, how will they be used and are they worth the money it will cost to develop them?

Fission rocket engines can be used to boost large payloads off earth into orbit or to the moon; they can be used for interplanetary exploration, starting from an earth orbit, traveling to Mars and other planets and returning to earth. Nuclear engines are definitely worth the development time and money, say the scientists; they can do jobs chemical rockets can't do or they can do the same jobs faster and cheaper (AW Mar. 23, p. 28).

The first application of nuclear rocket engines will probably be in the second stage of a two-stage space vehicle. The nuclear-powered vehicle would be boosted into a 300-mi. altitude earth orbit by a large chemical rocket based on the 1,500,000-lb. thrust engines now under development. Among other things, this would eliminate the problem of radioactive contamination caused by earth takeoffs. More important, it will keep reactor power requirements within the realm of anticipated capabilities. Orbit launching will reduce the required thrust from an amount greater than the total vehicle take-off weight (needed for lift-off from the earth's surface) to a small fraction of the initial weight.

Typical mission for such a vehicle might be what NASA's Rom and Johnson describe as a minimum energy round trip to Mars. The nuclear-powered craft accelerates away from its 300-mi. altitude earth orbit so that it coasts on an elipitic path tangent to both earth and Mars orbits under the gravitational influence of the sun. After 259 days, the space vehicle arrives at Mars where it decelerates into a Martian orbit. It waits here 455 days for Mars and earth to get back into a favorable position for a 259-day return trip to an earth orbit. The total trip requires 973 days and a total velocity increment of 6.9 mi. per second.

Mars Mission

Assuming that NASA's 1,500,000-lb. thrust chemical rocket now under development will be capable of boosting 25,000 lb. into a 300-mi. altitude earth orbit, Rom and Johnson developed the following nuclear rocket concept for the 973-day round-trip Mars mission. Total weight of the nuclear-powered vehicle, if measured on earth, would be 25,000 lb. The payload will weigh 5,500 lb.; reactor, 1,900 lb.; control rod mechanism, nozzle, pressure shell, solar batteries and guidance system, 500 lb.; structure, 500 lb.; propellant and tanks, 16,600 lb.

The fission reactor will have a maximum fuel element temperature of 5,000F, a maximum moderator temperature of 4,000F. Hydrogen flow rate

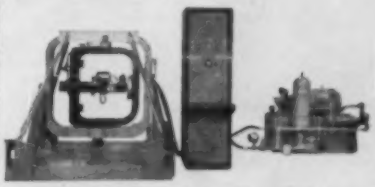
Camera Photographs Sputnik Track

Camera used for photographing track of the Soviet Sputnik satellite is shown in use at the astronomical observatory of the Latvian University in Riga.

your avionic
TESTING PROBLEMS SOLVED!

Radome Boresight Error

The CTI Radome Boresight-Error Measuring System satisfies MIL-R-7705A(ASG), including type II radomes. Boresight error is automatically recorded directly in milliradians with an accuracy of ±0.1 milliradian. Percent transmission and antenna patterns with or without the radome are also plotted. Available from S through K_a bands and infrared. Model 150C for monopulse and conical scan, Model 150B for bombing-type and other shaped-beam radars.



Flight and Altitude Simulation

Three-Axis Flight Simulator reproduces roll, pitch, and yaw positions, velocities, and accelerations for accurate analysis of flight control systems and inertial guidance platforms in the laboratory. Dynamic Altitude Simulator (not shown) produces 0-to-10-cps altitude fluctuations through range of ±700 feet at levels up to 80,000 feet.

Quality Control and Ground Support

Only automatic testing can assure the reliability of electronic equipment where time, manpower, or accuracy is critical. Used for pre-flight, maintenance, and production tests, CTI devices locate faults and incipient failures in seconds. Model 180 Tape-Programmed Supertester for circuits and systems; Model 165 Cable Tester for wiring harnesses; custom equipment to your requirements.

Write for full information

Engineers: Career opportunities are available at CTI

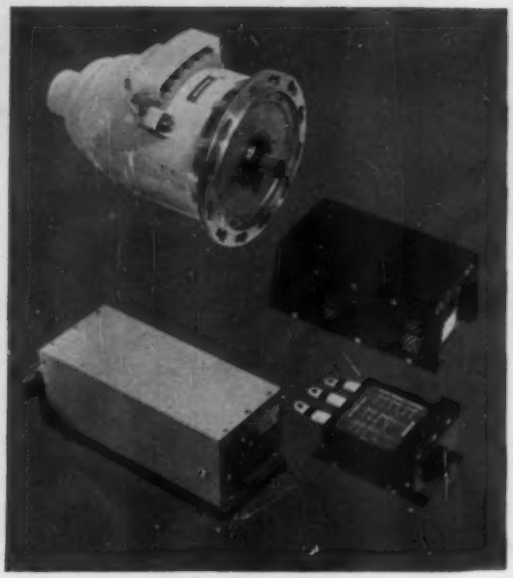
CTI
CALIFORNIA TECHNICAL INDUSTRIES
DIVISION OF TEXTRON INC.
BELMONT 7, CALIFORNIA

Foremost in Automatic Testing

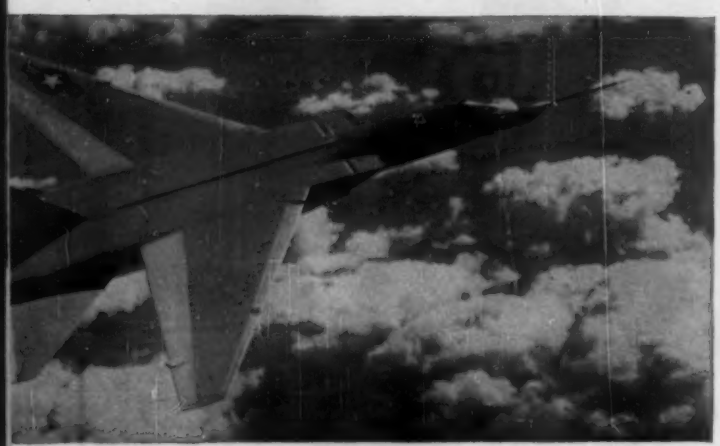
CAPABILITIES FOR DEFENSE

Westinghouse electrical systems, using first brushless generator, proved in thousands of flight hours

NOW IN FULL-SCALE PRODUCTION. The world's first aircraft brushless generators have a key role in advanced electrical systems provided by Westinghouse for today's military and commercial aircraft. The 40 kva units above are standard in Boeing 707 jetliners. First introduced in 1954 by Westinghouse Aircraft Equipment Dept., Lima, Ohio, these dependable generators have performed thousands of flight hours on the Boeing 707 and the Air Force B-58.



LEADER IN AIRCRAFT ELECTRICAL SYSTEMS. Westinghouse has been producing aircraft electrical systems since World War I—has built more a-c electrical systems for aircraft since World War II than any other company. Shown is the brushless air-cooled generator with control apparatus.



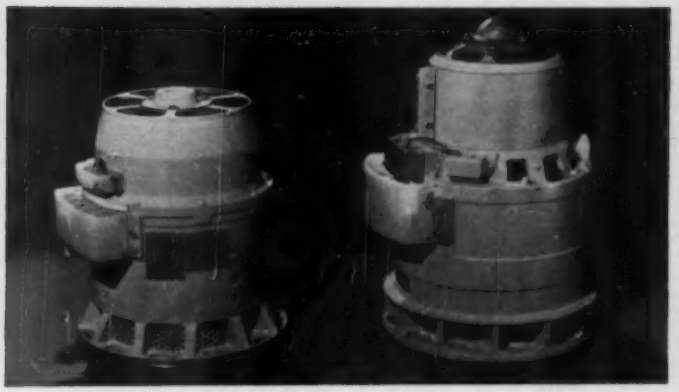
NAVY—The North American A3-J, completing flight tests preparatory to joining the fleet, uses the Westinghouse electrical system, including oil-cooled brushless generators.

AIR FORCE—The Convair B-58 Hustler employs the Westinghouse electric power system, including oil-cooled 40 kva brushless generators.

LONGER SERVICE LIFE and greater reliability result from the elimination of commutators, carbon brushes and collector rings, shown at right. A single internal rectifier bundle, held by girl, replaces them. High-temperature silicon diodes, produced by Westinghouse research in semiconductors, make this possible.

OIL-COOLED GENERATOR for Convair B-58 Hustler achieves major breakthrough of temperature barrier in electrical generator design—is cooled by MIL-L-7808 oil, having inlet temperature of 300° F. Usual generator troubles are eliminated—no brushes, commutating or slip-ring parts to wear, Results: greater economy, less frequent overhaul.

AUTOMATIC FUNCTION SIMULATOR, one of the newer testing techniques used by Westinghouse, assures more reliable protective devices for electrical systems. This machine subjects protective control panel to as many situations as it will encounter in flight operations.



BRUSHLESS VERSUS BRUSH-TYPE GENERATOR. Both generators are 40 kva. The brushless generator on the left above uses less space and weighs less. Longer life is assured—air-cooled brushless generators are guaranteed for 3,000 flight hours, bearings up to 1,500 hours. Brushless generators with even greater life are under test at Westinghouse.

ROBOT CIRCUIT TESTER uses punched tape to check circuitry of control equipment with 100% accuracy, 60 times faster than previous techniques. Westinghouse automatic circuit-testing facilities speed production, eliminate chance of human error, improve product reliability.

COMMERCIAL—The Boeing 707 uses Westinghouse electrical system, including air-cooled brushless generators—proved in thousands of flight hours.

Westinghouse

DEFENSE PRODUCTS

1000 CONNECTICUT AVENUE, N.W., WASHINGTON 6, D.C.

AIR ARM DIVISION
AVIATION GAS TURBINE DIVISION
ELECTRONICS DIVISION
AIRCRAFT EQUIPMENT DEPARTMENT
ORDNANCE DEPARTMENT

YOU CAN BE SURE... IF IT'S Westinghouse

will be .35 lb./sec. The hydrogen will be ejected from the expansion nozzle at a temperature of 4,500F and with a velocity coefficient of .96. The nozzle will have stainless steel walls and an area ratio of 50:1. Specific impulse of the system will be 940 sec.; thrust, 330 lb. Power rating of the reactor will be 6.7 megawatts (1 mw.-1,341 hp.).

The hydrogen will be stored in a .020-in. stainless steel tank which is pressure stabilized. (Pressurized helium would probably be used to replace the hydrogen as it is pumped out.) For maximum protection against reactor radiation, payload and electronic equipment will be located on top of the hydrogen tank; i.e., opposite from the powerplant end. There is no provision made for shielding the liquid hydrogen tank from the reactor. Assuming that the tank will subtend an angle less than 20 deg., Rom and Johnson calculate less than 1% of the hydrogen will be evaporated as the result of reactor operation and that any effective shielding would weigh more than the evaporated propellant.

Solar shielding is another story. To protect the liquid hydrogen from solar radiation during the long interplanetary trip, three lightweight reflectors, made from thin, gold-plated plastic sheets, are located in front of the tank. While coasting, the vehicle is pointed toward the sun to make effective use of the radiation shields.

Should it become possible to increase operating temperatures from 4,500F to 6,000F, specific impulse will jump to 1,330 sec., propellant and tank weight will drop to 12,800 lb. and this same rocket will be able to carry a 9,300-lb. payload.

If the initial weight of the vehicle in orbit is increased from 25,000 lb. to 100,000 lb. to provide for additional hydrogen, then the same nuclear powerplant (6.7 mw.) will enable the vehicle to make a Mars round trip in 508 days with a 7,400-lb. payload. For a 4,500F operating temperature, payload capability on the 508-day mission would be 1,100 lb. Total velocity increment required for the 508-day mission is 9 mi./sec.

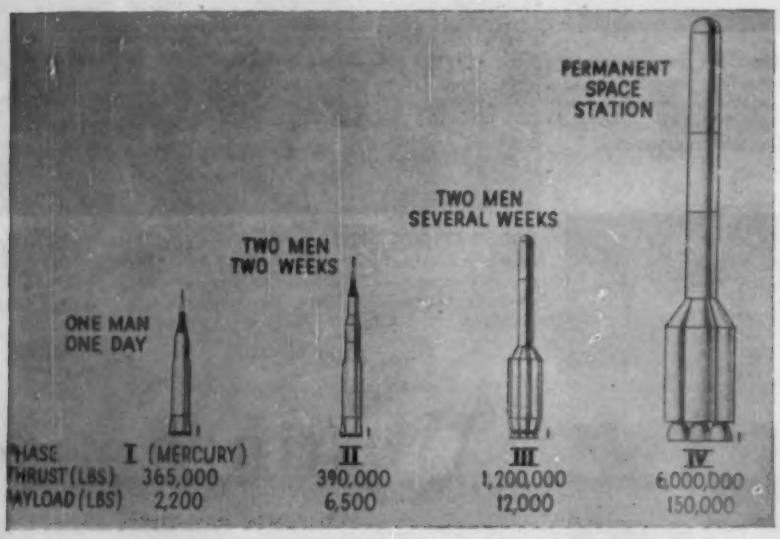
Scaling Up

For more ambitious missions, it will be necessary to scale up both the powerplant and the vehicle. In the case of the 570-day, round-trip Mars mission with a 49,000-lb. payload (see table), for example, the total required velocity increment becomes 14 mi./sec. and the power level of the reactor would have to be raised from 6.7 mw. to 100 mw. Rom and Johnson believe this would prove a relatively simple task.

Initial weight of the vehicle in orbit would go to 500,000 lb. Most of the additional weight will be taken up by hydrogen and its tankage. Powerplant weight would increase from 2,400 lb. to 17,000 lb. Thrust would be scaled up from 330 lb. to 35,000 lb. To achieve the 49,000-lb. payload capability, 6,000-F operating temperatures would be required. At 4,500F operating temperatures, payload capability for this mission is only 7,500 lb. (The 100,000-lb. vehicle could make this 570-day excess energy mission, but it would not be able to carry any payload unless operating temperatures were more than 5,500F.)

By comparison, a chemical rocket with a specific impulse of 400 sec. could not perform either the 508-day or the 570-day round-trip Mars mission. It could make the 973-day minimum energy Mars round trip, but its payload capability would be only 1,800 lb. —less than one third that of the low energy nuclear fission rocket. On the other hand, a nuclear electric ion propulsion system with a specific impulse of 5,000 sec. and an acceleration capability of 10^{-4}g (acceleration of the fission system is figured at approximately 10^{-3}g) could carry significantly more payload than the fission rocket on the two lower powered Mars missions; but its trip time will be considerably longer due to its low acceleration.

It is unlikely that the nuclear electric system would be able to make the 570-day extra energy Mars round trip. This mission calls for only a 30-day wait in Mars orbit (including time for acceleration and deceleration), and it is calculated to require a minimum accelebration of $2x4^{-4}$g to accomplish this mission. If some trajectory is found that will enable a nuclear electric rocket to carry out this mission, the system will have to achieve large amounts of additional energy at the expense of payload.


PERMANENT SPACE STATION
TWO MEN SEVERAL WEEKS
TWO MEN TWO WEEKS
ONE MAN ONE DAY
PHASE I (MERCURY) II III IV
THRUST (LBS) 365,000 390,000 1,200,000 6,000,000
PAYLOAD (LBS) 2,200 6,500 12,000 150,000

NASA Plans Orbiting Laboratories

Development plans for the National Aeronautics and Space Administration's manned orbiting laboratories begin with the Mercury vehicle using an Atlas booster. Second is Vega, a modified Atlas with GE Vanguard for second stage and a third stage storable liquid engine. Next are clustered engine vehicles concluding with concept of Nova (AW Mar. 30, p. 28).

1.5 Million lb. Rocket Test Unit Being Built

Construction of a rocket engine test stand for testing liquid-propellant rocket engines delivering up to 1,500,000 lb. thrust is under way at Edwards AFB, Calif. A contract in excess of $800,000 for basic construction of the facility was awarded Mid-Valley Utility Constructors, Inc., industrial builders and engineers of Houston, Tex., by Rocketdyne Division of North American Aviation. Three-stand testing complex at Edwards will be operated by Rocketdyne for National Aeronautics and Space Administration.

Western Electric Gets Anti-Missile Contract

Western Electric Co. has been awarded an $8,671,000 Army contract for continued research and development work on the Nike Zeus anti-missile missile program. Work under the contract will be performed at Bell Telephone Laboratories, Whippany, N. J.; Douglas Aircraft, Santa Monica, Calif.; Continental Can Co., Coffeeville, Kans., and Goodyear Aircraft Co., Akron, Ohio.

AIR TRANSPORT

20th
Edition
1959

Official Publication
of the Air Transport
Association of America

FACTS AND FIGURES

The Standard Reference of
United States Scheduled
Air Transportation

THE PRESIDENT'S MESSAGE

Why the jets? What prompts the scheduled airline industry to invest more than three times its net worth to buy new equipment? Why should the airlines and its industry organization spend so much time and trouble trying to convince Government agencies that the civil jet age will be a good thing for the nation and that a climate of freedom is essential? Why not give up in the face of obstacles, man-made and otherwise, and merely stick with what we have?

There are many answers to those questions. During the past few years of detailed planning and preparation, airline people have referred to them all. There is the obvious value of a mighty 600-mile-an-hour airlift, paid for by private money, and available under the Civil Reserve Air Fleet plan to the nation in time of emergency. There is also the equally obvious national interest value of effective competition on a world-wide basis with the civil jets of Aeroflot, the Russian airline.

However, I think if I were pressed to provide a single answer, I would do it in the words spoken to me recently by an executive of one of our member airlines. He said:

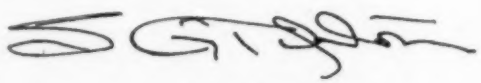
> "We're fighting to save time for people and time is just about the most precious possession people have."

It is that energetic desire to improve constantly its service to the public that has pressed the U.S.-Flag airlines forward into the jet age. This, of course, is not a new attitude on the part of the airlines. Although the jet re-equipment program is the most revolutionary, both in terms of managerial effort required and in terms of benefit for the nation, it is actually the fifth major equipment change since World War II.

The traveling public has responded to this airline desire to serve the public. It was a matter of considerable pride that in 1958, in spite of a general economic slump, that the airlines maintained the same traffic level as the year before, even while railroads and buses were slipping in passenger traffic.

The progress of the airlines in the last two decades has come about by a fruitful blend of cooperation and competition. Cooperation, that is, through the ATA and otherwise, in areas such as safety development, improvement of operational techniques, and in techniques designed to make things more convenient for the passenger or shipper. Competition, of a particular intense variety, is carried on in matters of sales promotion and market development.

The Congress, when it adopted the Civil Aeronautics Act in 1938 and enacted the Federal Aviation Act in 1958, directed the Government to promote the sound economic development of the air transport industry, legislated wisely and well. The future progress in the public interest now depends upon the ability of the industry and the Government to work together effectively in applying this Congressional mandate.



S. G. TIPTON

Definition of Terms

Passenger Miles and Ton Miles

AVAILABLE SEAT MILES FLOWN. Total seat miles available for sales in scheduled service.

AVAILABLE TON MILES. Total ton miles of lift capacity available for sales in scheduled and charter service.

CHARTER FLIGHT. Transportation of passengers or property on other than scheduled and designated extra section flights.

EXPRESS TON MILE. A ton of express flown one mile.

FREIGHT TON MILE. A ton of freight flown one mile.

PASSENGER MILE. One passenger flown one mile.

PASSENGER LOAD FACTOR. The percentage of available seat miles actually sold in scheduled service.

PASSENGER TON MILES. Passenger miles converted to ton miles. (See definition of revenue ton miles.)

REVENUE PASSENGER MILES. The number of fare paying passengers flown times the length of trip in miles. This is the amount of available seat miles sold.

REVENUE PLANE MILES. Aircraft miles flown in scheduled service.

REVENUE TON MILES. The ton miles sold in scheduled and charter service. In the construction of this traffic measure passenger miles are converted to ton miles on the basis of about 10 to 1. That is, ten passengers with allowable free baggage are accepted as equalling one ton.

SEAT MILE. One passenger seat, filled or unfilled, flown one mile.

TON MILE LOAD FACTOR. Percentage of available ton miles sold in scheduled and charter service.

U. S. MAIL TON MILE. A ton of mail flown one mile. The mail figures are in two categories. These are defined as Priority and Non-Priority. Priority mail includes air mail and air parcel post. Non-priority mail is first class mail that moves in air service. At present non-priority mail is being flown on an experimental basis between certain selected cities.

Revenues and Profit and Loss

EXPRESS REVENUE. Revenues accrued from the carriage of express.

FREIGHT REVENUE. Revenues accrued from the carriage of freight.

INCOME TAXES. Federal income taxes.

NET OPERATING INCOME. The total operating revenue from air transportation services less the operating expenses (see definition of Operating Expenses). Net Operating Income is before taxes and interest charges and does not include non-operating items.

NET PROFIT OR LOSS. Net income after Federal income taxes—the amount available for dividends or investment in the business. This figure is subject to change because of the later adjustment of some accounting transactions and through revision of mail rates and subsidy by regulatory action.

OPERATING EXPENSES. The expenses incurred in the conduct of the business except for such items as debt financing and other non-operating items.

RATE OF RETURN ON INVESTMENT. Total return, i.e. net profit plus interest paid on long term debt, as percent of average investment. Investment is the average of total net worth (stockholders equity) plus long term debt at the beginning and end of the year.

PROFIT MARGIN ON SALES. Net profit after interest and after taxes as per cent of operating revenues.

OTHER REVENUE. All other revenues, including excess baggage, chartered services, foreign mails, penalties for failure to cancel reservation, service charges on non-revenue transportation of employees and special services such as photography and crop dusting.

PASSENGER REVENUES. Passenger revenues from scheduled operations.

PUBLIC SERVICE REVENUES. Payments by the Federal Government to insure air service to communities in the United States and its territories which could not otherwise afford it; to maintain essential international air routes which are not yet self-supporting; and to develop helicopter service.

U. S. MAIL REVENUE. Service revenue for the transportation of mail. This is the amount paid by the Post Office to purchase air transportation for mail, and is not subsidy.

Air Transport

FACTS AND FIGURES

20th Edition, 1959

The year 1959 is the first year of air transport operation under the new Federal Aviation Act, passed last year. To demonstrate how the industry has increased its public usefulness over the years, this edition of Facts and Figures compares two decades of growth by showing figures for 1939, 1949, and 1958. In addition, the three years prior to 1958 are listed to show a more recent pattern of growth. Revised data filed by the scheduled air carriers with the Civil Aeronautics Board and the records of the Interstate Commerce Commission served as the major sources of the statistics.

Aircraft Operations at F.A.A. Airport Towers 108
Aircraft Owned and on Order 121
Air-Rail Fare and Travel Time Comparisons 122
Alaskan Airlines .. 104, 105, 107, 110, 113, 115, 118, 120, 123
All Cargo Airlines 104, 106, 108, 110, 113, 115, 118, 133
Assets, Liabilities and Stockholders' Equity 116
Average Length of Haul 120
Average Revenue Per Passenger Mile 120
Classes of U. S. Commercial Air Carriers 123
Consolidated Industry 106, 108, 110, 113, 115, 119, 120
Definition of Terms 95
Directors of Air Transport Association ..... Back Cover
Domestic Trunklines 102, 105, 107, 109, 111, 114, 116, 120, 122, 123
Helicopter Carriers 104, 105, 107, 109, 112, 114, 117, 120, 123
Intercity Passenger Mile Market 119
International and Overseas 103, 105, 107, 110, 112, 115, 117, 120, 122, 123
Local Service ... 103, 105, 107, 109, 112, 114, 116, 120, 123
Members of Air Transport Association ..... Back Cover
Officers of Air Transport Association ..... Back Cover
Operating Expenses 111
Operating Revenues 109
Personnel Employed 106
President's Message 94
Profit or Loss Summary 114
Revenue Passengers Carried 120
Revenue Ton Mile Traffic Carried 107
Safety Records 122
Service Available and Utilized 105
Territorial Carriers 104, 105, 107, 109, 112, 114, 117, 120, 123
Year in Review 96

THE YEAR IN REVIEW

1958 was the twenty-first year of airline operations under the Civil Aeronautics Act. The year saw, not only the inauguration of commercial jet transportation, but other developments that will also have significance in the years to come.

● **The Federal Aviation Act.** During the year, the Congress enacted the Federal Aviation Act of 1958. The Act repeals the Air Commerce Act of 1926 and the Civil Aeronautics Act of 1938. It created the Federal Aviation Agency with this objective: "To provide for the safe and efficient use of the airspace by both civil and military operations, and to provide for the regulation and promotion of civil aviation in such manner as to best foster its development and safety."

Incorporated into the new agency are the Civil Aeronautics Administration, the Airways Modernization Board, and the safety-rulemaking authority of the Civil Aeronautics Board.

The Administrator, E. R. Quesada, appointed by the President, has the authority to "regulate establish, operate and improve air navigation facilities; to prescribe air traffic rules for all aircraft; and to conduct related research and development activities."

● **The Cherington–Quesada Report.** This important report, "The Status and Economic Significance of the Airline Equipment Investment Program," was sent to Congress by President Eisenhower in August. Written by Paul W. Cherington, Professor of Business Administration, School of Business, Harvard University, it was presented to the President by E. R. Quesada, the President's Special Assistant for aviation matters.

Writing to Congress, President Eisenhower said: "This report sets forth, in some detail, the present status of the major air carriers and discusses their ability to implement their investment program of approximately $4 billion in aircraft and equipment. This program is of such a size as to hold some significance to the national economy over the next few years."

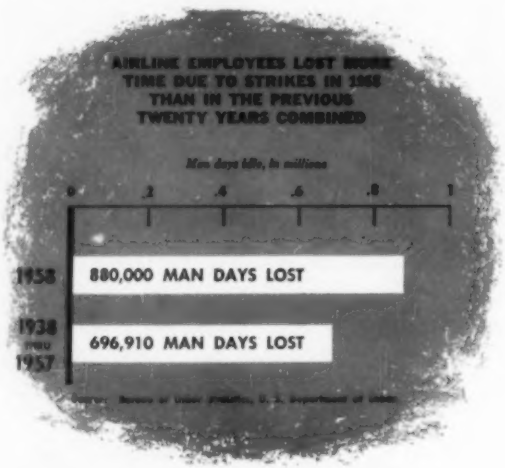
● **The Transportation Tax.** In 1958, the three per cent tax on shipment of freight for hire carriers was repealed.

Still remaining is the 10 per cent Federal transportation tax on passengers.

● **Balance at the Bargaining Table.** In November, six airlines joined in an agreement that allows limited financial assistance to those members of the agreement shut down by strikes. The payments are based on the additional net revenues received by the carriers still in operation.

The agreement was presented to the Civil Aeronautics Board and in a press release decision the CAB said the plan was "not adverse to the public interest and should be approved."

This plan was advanced by the airlines to deter strikes which in 1958 alone forced cancellation or disruption of the travel plans of over 2,500,000 passengers.



Historically, airlines have not had the economic resources to withstand long and costly strikes. This situation has led to an imbalance at the bargaining table where labor uses the strike, and the strike threat, most effectively. Most airline unions are national in scope and for years have employed various forms of mutual aid to assist one another.

● **The Airlines Hold the Line.** Despite the continually upward spiraling of costs over the last 20 years the scheduled air carriers of the U. S. are now offering the public a fare level only 3.2 per cent greater than the 1939 level.

During this time, the airlines have greatly expanded their usefulness by adding more cities to their network, carrying more passengers, more freight and by increasing their service to the Post Office Department.

Their contribution to the national defense has also increased. Today, more than 300 long-range, four-engine aircraft are available to the Department of Defense on 36 hours' notice for airlift in the event of a national emergency.

On Stage in 1958—The Civil Jet Age

Last year, the first U. S. commercial pure jet planes went into scheduled operation.

Observers were quick to note the many benefits that will flow from this new era in public transportation. The speed of the new planes, the comfort they will afford passengers, the almost-revolutionary changes that will improve the lot of the traveler, shipper and postal user, were all cited as some of the major benefits.

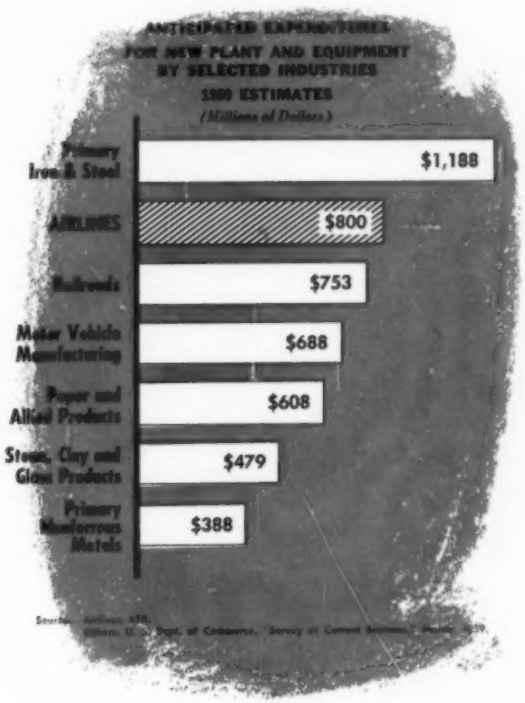
This Age means business, not only in terms of the multi-billion-dollar investment that will go into the planes and the supporting equipment right now, but more importantly, in the years to come.

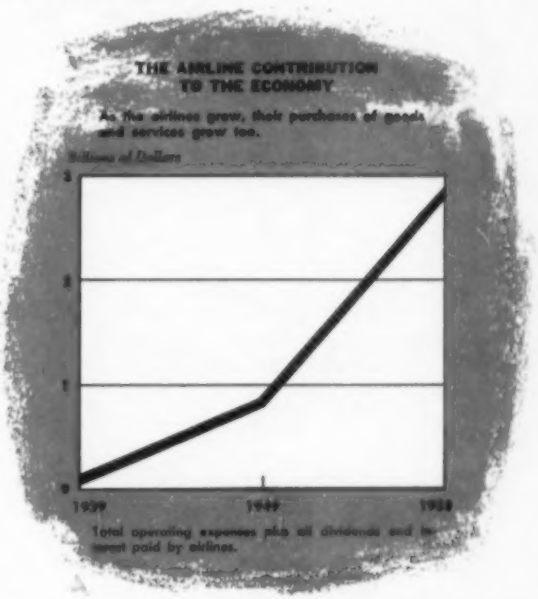
Here is how the investment will be apportioned:

- $2,500,000,000 for new aircraft, along with spare parts and engines.
- $ 250,000,000 for supporting ground equipment, hangars, maintenance bases and other equipment
- $ 220,000,000 to be spent by others for facilities but to be taken over, and paid for, by the airlines.

The investment for 1959 alone compares favorably with the capital expenditures of basic manufacturing industries.

The overall importance of the investment to the general economy promises to have a far greater, and more lasting, benefit in the long run than the temporary pump-priming effect of the aircraft orders.





The investment is radiating out into the nation's economy, creating more jobs, and making existing jobs more secure, by the need to; (1), supply the airline orders, and; (2), maintain this enormous fleet when it is delivered and in scheduled service.

WHERE THE AIRLINE REVENUE DOLLAR CAME FROM IN 1958*

— — — — — — — — — AND — — — — — — — — —

WHERE THE AIRLINE REVENUE DOLLAR WENT

*For the 12-month period ending September 30, 1958.

Mr. Cherington estimated that the jet program of the airlines directly involves an average of 80,000 to 125,000 net additional jobs annually in the economy and indirectly still more.

He also saw the equipment program of the airlines as a matter of "direct concern" to the income of 5,000 business firms.

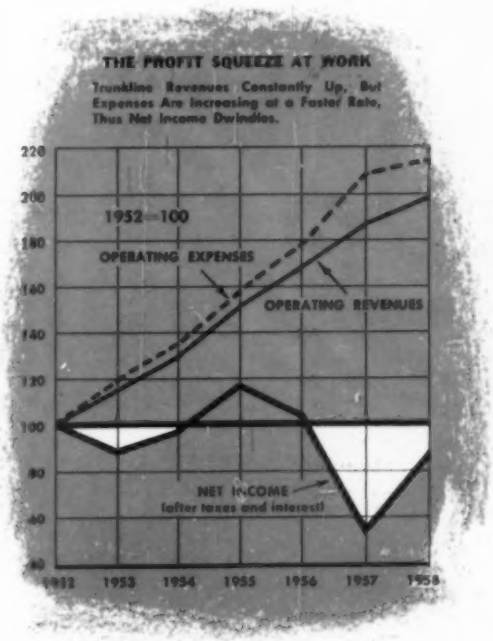
The airlines are good customers of more than 10,000 different concerns who supply the more than 100,000 different items that carriers need.

Last year their spending reached an all-time peak when they pumped back into the economy more than two billion dollars to suppliers, employees and, through taxes, to Federal, state and local agencies.

The largest part of this re-investment in the economy was for wages and salaries, a total payroll of about $950,000,000. The rest of the airline expenditures were spread out over an almost infinite list of supplies; from thumb tacks to the enormous, and expensive, rubber tires for the aircraft themselves.

A Look at Airline Earnings

Financially, 1958 was the same kind of frustrating year that the air transport industry had experienced in 1957; record-breaking revenues, all-time highs in traffic but, when all the bills were paid, a net profit that remained at a critically low level.



Specifically, the airlines of the United States last year took in $2,237,469,000 in operating revenues, spent $2,131,542,000 for operating expenses and kept only $52,914,000 as a net profit, after taxes and interest.

The revenue and the expense figures were the highest ever; the net profit compares with $56,046,000 in 1951 when the airlines grossed $1,019,672,000, less than ½ of the 1958 level.

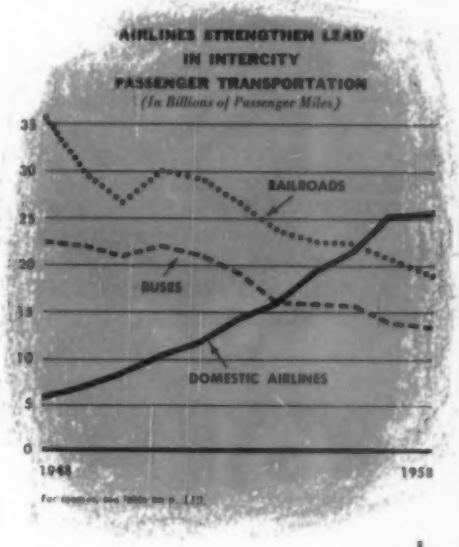
The Civil Aeronautics Board granted two temporary fare adjustments during the last year. Approximately 70 million dollars were added to domestic airline revenues because of these fare adjustments:

- On February 10, the CAB authorized the domestic airlines to raise their basic fares by 4 per cent, in both first class and coach and add $1 per ticket.
- In October, the CAB permitted the domestic airlines to eliminate the roundtrip discount of 5 per cent, remove the free stopover privileges, and reduce the discount for family dependent travel from 50 per cent to 33⅓ per cent.

Airline Traffic Continued to Gain

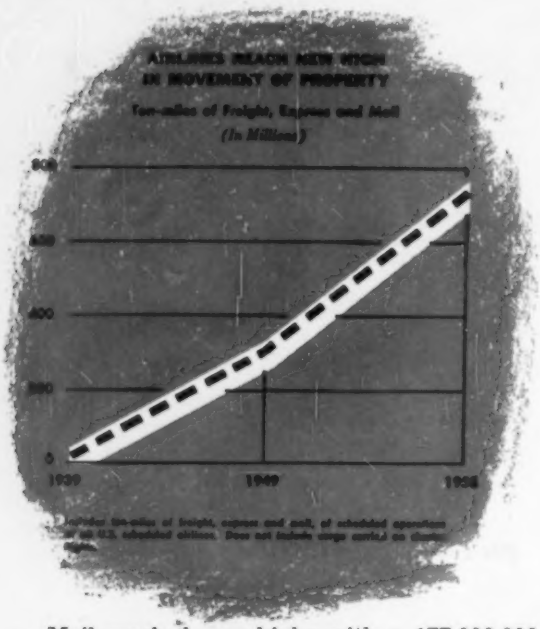
Overall, airline traffic showed an increase over 1957. This increase was significant when viewed against the backdrop of a nationwide recession during part of the year and a series of airline strikes during the latter part of the year.

The domestic airlines; compared with their public transportation competitors, the railroads and the buses; more than held their own. While



the airlines maintained their 1957 level, the railroads' passenger traffic dropped 14 per cent and the buses dropped two per cent.

For 1958 compared to 1957, the scheduled airlines operated a record high of revenue ton miles, 4,075,000,000, but it was only a 1.8 per cent increase over the previous year.



Mail reached new highs with a 177,000,000 ton-mile haul. Express was up six per cent to a new peak of 48,837,000 miles but freight traffic, due to the cessation of common carriage by one of the major all-cargo carriers, showed a drop.

Progress Under the Aviation Acts

During 1958, the Civil Aeronautics Act of 1938 was succeeded by the Federal Aviation Act of 1958. The promotional provisions of the original act were carried through without a word changed. That provision, the basic tenet of the Civil Aeronautics Board, is: "The encouragement and development of an air transportation system properly adapted to the present and future needs of the foreign and domestic commerce of the United States, of the Postal Service and of the national defense."

In 1958, the twenty-first year of operation under the Acts, the airlines have reached new peaks of usefulness in every category.

This growth has been possible because the airlines in their efforts to serve the public have provided service in continuously greater abundance, while improving their dependability over the years.

The air transport industry has been aided by public service revenues, or subsidy, just as the waterways and railroads were helped when they were young industries.

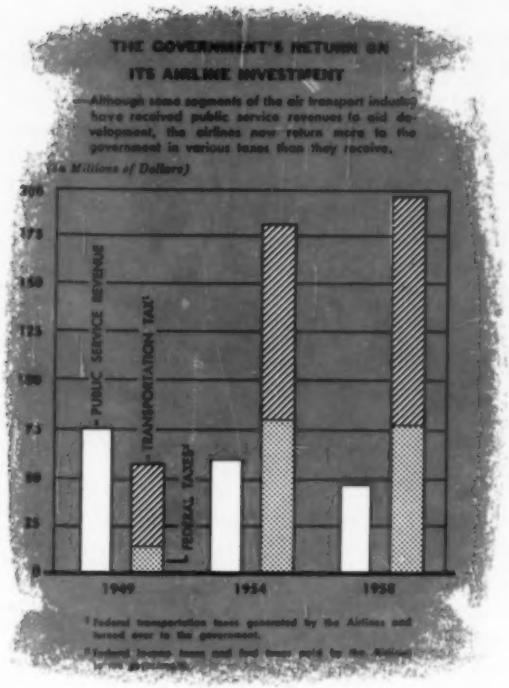
THE AIRLINE STORY

Ever Increasing Usefulness Over The Years

All classes of Certificated Air Carriers	1939	1949	1958
Number of Airlines	23	45	55
Cities Served (excluding Alaskan points) [2]	286	638	703
Aircraft in Service	347	1,083	1,900
Seats Available (Daily)	5,100	35,900	103,700
Cruising Speed of Fastest Transport	220 mph	315 mph	590 mph
Number of People Employed	13,300	76,000	146,000
Total Airline Payrolls	$24,000,000	$349,000,000	$950,000,000
U. S. Mail Ton Miles	8,610,000	61,144,000	177,430,000
Number of Passengers Carried	1,864,000	16,723,000	49,075,000
Average Fare	5.62¢	6.23¢	5.8¢
Ton Miles of Freight Carried	2,713,000 [1]	112,500,000	501,591,000

[1] Freight and Express combined.

[2] Early figures for Alaska not available but in 1958 there were 263 points served.


THE GOVERNMENT'S RETURN ON ITS AIRLINE INVESTMENT
Although some segments of the air transport industry have received public service revenues to aid development, the airlines now return more to the government in various taxes than they receive.
(In Millions of Dollars)
PUBLIC SERVICE REVENUE
TRANSPORTATION TAX[1]
FEDERAL TAXES[2]
1949
1954
1958
[1] Federal transportation taxes generated by the Airlines and turned over to the government.

While the total amount of aid that has been given to the domestic airlines since 1938 is small in relation to many other support programs of the United States government, the country has benefitted from the investment in an actual return that now approaches the billion-dollar-mark.

Subsidy now accounts for only 2.2 per cent of the total airline revenues. The greater part of the government aid today goes to the local service airlines in order to guarantee air service to smaller communities. Other subsidy payments go to help develop the experimental helicopter service in three cities, for Alaskan airlines, and to maintain national interest routes in Latin America. No domestic trunk line is now receiving subsidy.

Safety in the Air

The number one concern in the airline industry last year, as it has been in every year, was the matter of safety in the air.

The airlines in cooperation with the Civil Aeronautics Administration, now part of the Federal Aviation Agency, and the military services, have been working toward reducing the hazard of mid-air collisions by seeking a means of positive separation of aircraft flying the nation's airways.

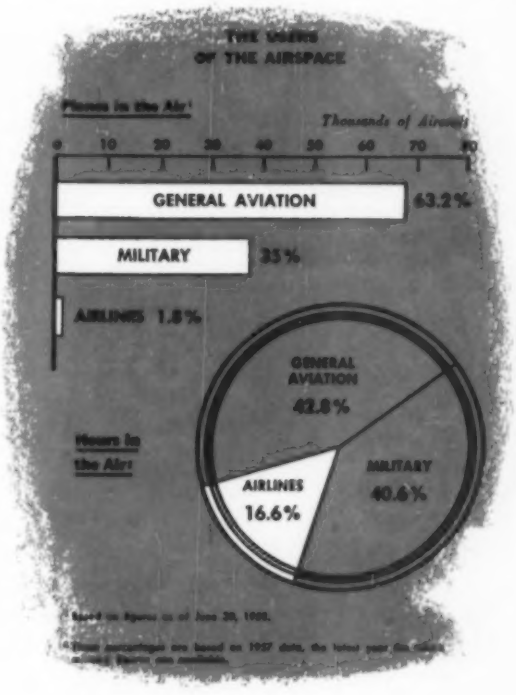
The airlines had voluntarily placed all of their planes flying above 18,000 feet on instrument flight rules, which meant that above that altitude, all airliners were separated from each other. This level was lowered in mid-1958 to the 10,000 foot level. During the year, the military also adopted some restrictions of "see-and-be-seen" operations.

Another step to make air transportation still safer was the setting up, by the Civil Aeronautics Board, of three Super Skyways that connect New York and Washington with Los Angeles and San Francisco. These special airways extend from 17,000 to 22,000 feet and no airplane is permitted to use, or even cross, these airways without specific permission of the traffic control centers.

Plans are now underway to extend this system of positive control highways to other parts of the air traffic control system.

Air Traffic Control and the New Jets

The new jets flying greater speeds and at higher altitudes, will be handled in the existing



system, but with special consideration. Working with the close cooperation of the military, the high-flying jets will be tracked, and radar separation will be provided, for aircraft operating above 24,000 feet. This is being done by FAA traffic controllers and utilizes the existing long-range radar of the Air Defense Command.

The airspace—that rapidly dwindling natural, and public, resource—has now for the first time been placed under single, and unified, management. The management is the Federal Aviation Agency.

The Air Force estimates that the military planes fly about ten million hours a year—within the continental U.S. The general aviation planes fly about 11½ million hours a year and the airlines about 4½ million hours.

Complicating the problem of allocation is the fact that not all of the navigable airspace can be used. Areas around radio-TV towers and tall buildings and over natural preserves are closed off to all kinds of flying. Also, some 130,000 square miles over the continental U.S. are closed off to non-military flying.

The end result of the planning on the part of the airlines and the government, with the cooperation of the other users, the military and general aviation, has as its ultimate goal, safety.

The safety record of the airlines has demonstrated the wisdom of advanced planning, and the manufacturers ceaseless search for equipment and devices that will make flying safer today than it was yesterday, and safer tomorrow than it is today.

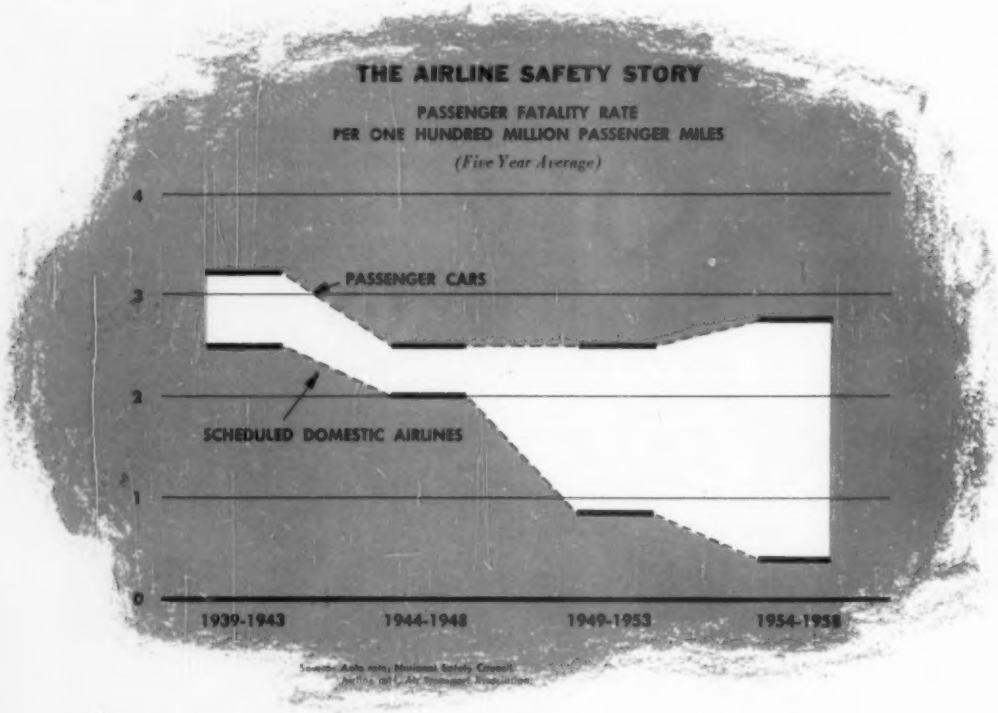
The record: In the last seven years, the domestic scheduled airlines have had a safety rate of less than one fatality for every one hundred million passenger miles.

On the basis of five year periods the scheduled airlines in 1954-58 had a fatality rate of .38 per hundred million passenger miles compared to 2.55 in the 1939-43 period.

DOMESTIC TRUNKLINES

The domestic trunk airline industry gained in all categories of traffic except one in 1958. Revenue ton miles flown in domestic operations totaled 2,750,900,000, an increase of 1.1 per cent.

The 12 trunklines flew a total of 24,435,-700,000 passenger miles in scheduled service over their domestic routes in 1958, a decline of 0.3 per cent from 1957.



Domestic trunkline freight traffic increase 10.1 per cent to 240,510,000 ton miles in 1958.

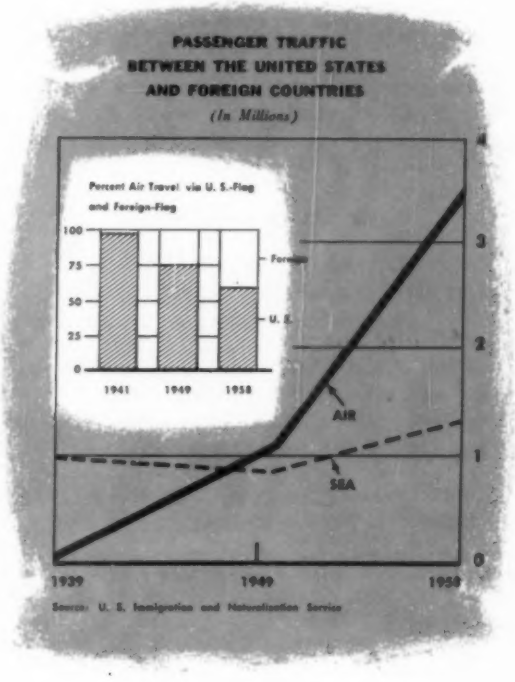
The trunklines gained also in mail and express volume. They flew 45,890,000 ton miles of air express, an increase of 7.3 per cent; 87,809,000 ton miles of air mail, up 7.0 per cent; and 16,155,000 ton miles of non-priority mail, a gain of 6.7 per cent.

Revenues reached a record high of $1,513,019,000 in 1958. However, expenses also rose to an all-time high; $1,418,486,000, leading to a net profit of $44,709,000 for the year. While $17,721,000 higher than in 1957, the 1958 net profit was $13,003,000 less than that in 1956 and about equal to 1951 earnings.

Trunkline jet programming indicates that a total of 62 pure-jet and 185 prop-jet airliners will have been delivered the end of 1959.

INTERNATIONAL AIRLINES

The fastest service in international airline history was introduced in 1958 but U.S.-flag airlines saw their share of the total market continue to shrink. Two-thirds of the increased air travel between the U. S. and foreign countries was secured by foreign flag airlines.



It was a record year for traffic. U.S.-flag airlines flew an all-time high of 5,974,600,000 revenue passenger miles, up 3.9% from the previous record total of 5,751,700,000 in 1957. Cargo ton-miles reached a new high of 128,925,000 for an increase of 4.6% over 1957.

The gap between air and sea travelers widened with air traffic accounting for three-fourths of the total U.S.-foreign market. But increased competition from foreign flag airlines was evident as those carriers, for the first time, carried more passengers to and from the U.S. than all steamship companies combined, increased their share of the total U.S.-foreign air market to 40% and, in such vital areas as the North Atlantic, widened their share to 59% by year end.

LOCAL SERVICE AIRLINES

Major objectives of the local service airline industry are fleet modernization to increase efficiency, improve service and stimulate traffic and to reduce subsidy. Two carriers introduced turbine-powered aircraft in 1958. Several others are introducing turbine aircraft and more efficient piston-engine airliners during 1959.

Guaranteed loan and related federal legislation aimed at facilitating the re-equipment program aided developments during the year. A capital gains bill, enacted in 1958, permits local service airlines to apply profits from the sale of older aircraft to the purchase of modern planes. Formerly proceeds were deducted from public service revenues.

While beneficial in securing equipment financing, these measures do not substitute for adequate earnings. In the "Local Service Rate of Return Case" before the Civil Aeronautics Board, the carriers are seeking regulatory policies that will provide opportunity for reasonable earnings. The Board has stated it will improve the regulatory framework and has taken some steps in that direction.

The local airline service pattern continues to expand rapidly. The 13 carriers were operating 35,586 unduplicated route miles at the end of 1958, some 2,000 miles more than a year earlier.

The number of cities served increased from 468 to 516 at the end of the year. It is significant that 283 of those communities would other-

wise be without scheduled airline passenger, mail and freight service.

The local service airlines gained in all categories of traffic in 1958. They carried 4,265,000 persons in scheduled service—10 times more than 11 years previously. They flew 820,200,000 passenger-miles, an increase of 9.8 per cent over 1957.

Because of traffic development and efficiency gains, the proportion of federal support has declined sharply. Public service revenues have dropped from about 65 per cent of total revenues in 1948 to 34 per cent in 1958.

HELICOPTER CARRIERS

During 1958, the scheduled helicopter carriers continued their upward traffic trend registered so markedly the previous year.

Revenue ton miles, the overall indicator of activity, were up 33.5 per cent for the year, from 448,000 to 598,000 a new high.

The helicopter lines carried 228,000 passengers during the year, a 54.1 per cent increase over the previous year. The passenger-mile figure was up, too, during 1958. The lines operated 4,885,000 passenger miles, a 43.9 per cent gain over the year before.

Available ton miles were at a new peak. The helicopter lines operated 1,497,000 available ton miles in 1958, compared with 1,056,000 in 1957, a gain of 41.8 per cent.

Together, the three helicopter lines operate 22 aircraft over 905 route miles serving 29 points.

THE ALASKAN CARRIERS

Alaska's entrance into the Union in the late summer of 1958 bodes well for future travel to our 49th State. A spokesman for the scheduled airline industry puts it this way:

"With admission of Alaska to statehood, our national frontiers have been materially broadened. As a result, added traffic volume is anticipated both from increased tourism and from the greater influx of industry and population. Routes covered by the Alaskan carriers serve the most densely populated and industrialized areas of Alaska and the airlines (Alaskan) should continue to participate in the future growth of the new State."

Revenue ton miles were up over 1957, 32,901,000 versus 32,513,000—a 1.2 per cent gain.

The Alaskan carriers flew more passengers during the year than they did the year before. 315,000 passengers were flown compared with 309,000 during 1957. Passenger miles were up, also, with 1958 showing an all-time peak of 163,800,000, 7.8 per cent over 1957.

TERRITORIAL CARRIERS

The territorial carriers flew more revenue ton miles in 1958 than in any previous year.

They reached 11,264,000 a gain of 24.3 per cent over 1957 when 9,065,000 revenue ton miles were flown.

Freight ton miles were up, to 1,587,000 from 1,536,000 a gain of 3.3 per cent.

In scheduled passenger operations, the territorial carriers dropped below the 1957 results. They carried 572,000 passengers in 1958 compared with 589,000 the year before. Similarly, the passenger mile figure was down, from 1957's 89,500,000 to 82,700,000 a drop of 7.6 per cent.

Total operating revenues reached a new high with a $9,396,000 total. Total operating expenses were $9,254,000 and net income, $142,000.

THE ALL-CARGO LINES

The all-cargo lines after allowing for the dropping of service by a major cargo-carrier show a gain of 18 per cent over the prior year.

On an industry basis their freight ton miles, which had been rising steadily, dropped back 21 per cent with a total 121,382,000 ton miles versus 155,126,000 for the previous year.

Total operating revenues for the all-cargo lines were $78,908,000 for the year.

Priority U.S. mail was also up for the year, with 2,040,000 ton miles flown as against 440,000 during 1957.

AVAILABLE SERVICE AND UTILIZATION

U. S. Scheduled Airline Industry

(For Selected Years, In Millions)

THIS TABLE SHOWS THE EVER INCREASING GROWTH IN THE SERVICES THE SCHEDULED AIRLINES ARE OFFERING TO THE PUBLIC AND THE INCREASING USE OF THIS SERVICE BY THE PEOPLE, THE GOVERNMENT AND SHIPPERS.
LOAD FACTOR IS THE PERCENTAGE OF CAPACITY WHICH IS SOLD.

	Available Ton Miles Flown	Revenue Ton Miles Flown	Ton Mile Load Factor (%)	Available Seat Miles Flown	Revenue Passenger Miles Flown	Passenger Load Factor (%)	Revenue Plane Miles Flown
Domestic Trunk Airlines							
1939	N.A.	76.5	.....	1,209.6	654.0	54.07	82.8
1949	1,517.4	801.2	52.80	11,117.7	6,570.7	59.10	323.2
1955	3,882.7	2,160.1	55.63	30,001.3	19,217.2	64.05	564.0
1956	4,393.2	2,417.0	55.02	33,752.6	21,643.1	64.12	622.1
1957	5,150.4	2,720.0	52.81	39,838.2	24,499.5	61.50	711.1
1958	5,190.2	2,750.9	53.00	40,695.0	24,435.7	60.05	700.6
Local Service Airlines							
1939[1]	.....	.....	.....	.....	.....	.....	.....
1949	46.4	14.2	30.69	477.9	134.7	28.18	24.5
1955	121.9	55.3	45.36	1,161.4	523.3	45.06	50.9
1956	145.6	66.8	45.91	1,385.0	633.2	45.72	59.5
1957	170.7	78.5	46.00	1,653.8	747.3	45.19	67.3
1958	185.4	86.6	46.71	1,793.5	820.2	45.73	72.3
Territorial Airlines							
1939	N.A.	.3	.....	5.5	3.1	56.74	.4
1949	10.1	5.2	51.45	91.3	52.6	57.19	4.0
1955	16.1	8.4	52.10	134.7	78.1	57.99	4.6
1956	16.0	8.5	53.03	147.9	83.9	56.70	4.6
1957	15.7	9.1	57.96	154.9	89.5	57.78	4.7
1958	18.4	11.3	61.41	143.1	82.7	57.79	4.4
Helicopter Airlines *(in thousands)*							
1939[1]	.....	.....	.....	.....	.....	.....	.....
1949	142	46	32.39	.....	.....	.....	412
1955	434	195	44.93	1,708	628	36.77	1,148
1956	567	277	49.03	3,561	1,588	44.59	1,315
1957	1,056	448	42.42	8,049	3,272	40.66	1,604
1958	1,497	598	36.95	11,419	4,885	42.78	1,675
International and Overseas Airlines							
1939	N.A.	77.2[2]	.....	134.4	71.8	53.46	7.6
1949	540.3	309.5	57.28	3,624.7	2,054.0	56.67	104.5
1955	984.6	633.8	64.37	7,012.1	4,410.8	62.90	130.7
1956	1,143.4	741.2	64.82	8,073.1	5,113.2	63.34	146.0
1957	1,292.9	827.0	63.96	9,038.1	5,751.7	63.64	155.7
1958	1,426.6	873.1	61.20	10,057.6	5,974.6	59.40	165.5
Alaskan Airlines							
1939[1]	.....	.....	.....	.....	.....	.....	.....
1949	20.3	11.2	55.32	38.9	15.4	39.64	3.9
1955	46.0	29.4	63.87	233.9	110.4	47.20	10.5
1956	66.9	44.8	66.98	284.1	137.0	48.21	11.3
1957	59.4	32.5	55.08	329.7	151.9	46.07	11.5
1958	59.9	32.9	54.94	369.0	163.8	44.39	11.5

See Footnotes at End of Table on Page 116

Available Service and Utilization *(continued)*	Available Ton Miles Flown	Revenue Ton Miles Flown	Ton Mile Load Factor (%)	Available Seat Miles Flown	Revenue Passenger Miles Flown	Passenger Load Factor (%)	Revenue Plane Miles Flown
All-Cargo Airlines							
1939[1]	.....	.....	.....	.....	.....	.....	.....
1949[1]	16.5	11.7	70.20	.....	.....	.....	2.8
1955	184.0	135.1	73.41	.....	.....	.....	17.1
1956	321.5	248.8	77.38	.....	.....	.....	23.5
1957	431.7	336.9	78.04	.....	.....	.....	23.3
1958	383.8	319.3	83.20	.....	.....	.....	16.1
CONSOLIDATED INDUSTRY							
1939[1]	.....	154.0[2]	.....	1,349.5	728.9	54.01	90.8
1949[1]	2,151.0	1,153.1	53.61	15,350.5	8,827.4	57.50	462.9
1955	5,235.7	3,022.2	57.72	38,545.1	24,340.4	63.15	779.0
1956	6,087.1	3,527.4	57.95	43,646.3	27,612.0	63.26	868.4
1957	7,121.5	4,004.4	56.23	51,022.7	31,243.1	61.23	975.3
1958	7,265.7	4,074.7	56.08	53,069.6	31,481.9	59.32	972.1

[1] Data not available for Alaskan airlines in 1939.
Local Service operations initiated in 1945.
Helicopter operations started in 1947, passenger service began in 1953.
All-Cargo Airlines began operations in fourth quarter of 1949.

[2] Revenue Ton Mile data for items other than passenger ton miles for International and Oversees carriers not available for 1939, hence total does not reflect these items.

N.A. Not Available.

Note: Available Ton Miles and Revenue Ton Miles include charter operations; all other items are for scheduled service only.

PERSONNEL EMPLOYED BY THE SCHEDULED AIRLINE INDUSTRY

(1940-1958)

Year	Pilots and copilots	Other Flight Personnel	Pursers, Stewards, Stewardesses	Communications personnel	Mechanics	Aircraft and traffic servicing personnel	Office employees	All others	Total
1940	2,279	33	1,036	193	5,413	4,277	7,689	1,131	22,051
1941	2,664	49	1,210	220	6,389	4,931	9,710	1,285	26,458
1942	3,146	241	1,131	1,610	12,882	7,384	11,083	2,236	39,713
1943	2,332	330	992	2,196	10,411	5,191	12,832	4,995	39,279
1944	3,345	277	1,516	2,501	9,963	5,748	15,234	4,023	42,607
1945	5,897	1,046	2,486	3,477	15,943	9,447	23,904	6,081	68,281
1946	7,220	1,503	4,421	5,031	23,376	12,770	31,587	10,646	96,554
1947	6,637	1,333	4,077	3,829	21,140	11,610	32,691	3,835	85,152
1948	6,926	1,515	4,142	3,661	21,828	11,662	31,145	3,729	84,608
1949	6,843	1,602	4,341	3,581	19,535	11,674	30,148	3,270	80,994
1950	7,277	1,521	4,427	3,403	19,606	12,256	31,138	3,158	82,786
1951	8,386	1,708	5,303	3,618	23,477	14,370	35,081	3,810	95,753
1952	8,770	1,852	5,859	3,653	26,162	15,588	37,894	4,294	104,072
1953	9,437	2,146	6,106	3,567	26,105	17,353	40,319	4,359	109,392
1954	9,495	2,525	6,363	3,332	25,173	17,855	40,670	4,128	109,541
1955	10,857	2,762	7,454	3,499	29,196	19,114	45,030	4,291	122,203
1956	11,386	3,384	8,097	3,605	30,962	20,657	49,336	4,076	131,503
1957	13,286	3,797	9,450	4,004	31,162	36,052	31,799	17,640	147,190
1958	12,944	3,829	9,847	3,908	29,221	35,415	29,602	18,103	142,869[p]

[p] These are preliminary figures based on reports from a majority of the airlines as of September 30th.

REVENUE TON MILES OF TRAFFIC CARRIED

U. S. Scheduled Airline Industry

(For Selected Years, In Thousands of Revenue Ton Miles)

THIS TABLE SHOWS, BY CATEGORIES, THE GREATER INCREASING USE OF THE SCHEDULED AIRLINES BY PASSENGERS AND COMMERCE

	Passenger[4]	Priority U. S. Mail	Non Priority[5] U. S. Mail	Express	Freight[3]	Charter Flights	Excess Baggage[4]	Total
Domestic Trunklines								
1939	64,577	8,608	.....	.....	2,705	.....	597	76,487
1949	624,219	40,874	.....	27,329	94,190	7,483	7,102	801,197
1955	1,825,631	71,859	14,175	49,603	174,017	5,737	19,046	2,160,068
1956	2,056,098	77,788	13,891	49,709	190,592	5,911	23,055	2,417,044
1957	2,327,334	82,057	15,137	42,752	218,432	6,335	27,983	2,720,030
1958	2,321,347	87,809	16,155	45,890	240,510	12,000	27,237	2,750,948
Local Service Airlines								
1939[1]	.....	.....	.....	.....	.....	.....	.....	.....
1949[1]	12,796	428	.....	320	436	194	60	14,234
1955	49,713	928	328	1,403	1,355	1,338	245	55,310
1956	60,156	1,192	344	1,687	1,624	1,520	320	66,843
1957	71,079	1,174	345	1,642	2,082	1,717	471	78,510
1958	78,055	1,330	395	1,801	2,241	2,196	575	86,593
Territorial Airlines								
1939	299	2	.....	.....	8	n.a.	2	311
1949	4,206	70	.....	124	618	123	66	5,207
1955	6,250	59	.....	n.a.	1,646	436	20	8,411
1956	6,710	63	2	.....	1,475	236	17	8,503
1957	7,259	63	1	.....	1,536	170	36	9,065
1958	6,611	67	2	.....	1,587	2,965	32	11,264
Helicopter Airlines								
1939[1]	.....	.....	.....	.....	.....	.....	.....	.....
1949	.....	46	.....	.....	.....	.....	.....	46
1955	60	96	.....	31	5	.....	3	195
1956	149	89	.....	31	7	.....	1	277
1957	311	92	.....	33	8	3	1	448
1958	465	84	.....	34	6	6	3	598
International and Overseas Airlines								
1939	77,233	n.a.	.....	n.a.	n.a.	n.a.	n.a.	77,233[2]
1949	220,805	19,772	.....	19,444	6,714	3,233	9,515	309,483
1955	453,195	52,409	.....	243	90,598	19,701	17,648	633,794
1956	524,369	55,158	.....	.....	109,235	32,652	19,757	741,171
1957	589,510	57,265	.....	.....	123,280	36,188	20,771	827,014
1958	597,326	65,825	.....	.....	128,925	60,832	20,195	873,103
Alaskan Airlines								
1939[1]	.....	.....	.....	.....	.....	.....	.....	.....
1949	1,659	479	.....	.....	618	8,449	27	11,232
1955	11,868	2,279	.....	.....	7,300	7,773	152	29,372
1956	14,719	2,383	.....	.....	7,948	19,527	241	44,818
1957	16,002	2,695	.....	.....	7,201	6,344	271	32,513
1958	17,289	3,102	.....	.....	6,940	5,270	300	32,901

See Footnotes at End of Table on Page 108

Revenue Ton Miles of Traffic Carried *(continued)*	Passenger[4]	Priority U. S. Mail	Non Priority[5] U. S. Mail	Express	Freight[3]	Charter Flights	Excess Baggage	Total
All-Cargo Airlines								
1939[1]	.....	.....	.....	.....	.....	.....	.....	.....
1949[1]	.....	.....	.....	.....	10,542	1,124	.....	11,666
1955	.....	.....	318	.....	107,945	26,796	.....	135,059
1956	.....	381	1,188	1,266	140,420	105,526	.....	248,781
1957	.....	440	1,409	1,638	155,126	178,249	.....	336,862
1958	.....	2,040	621	1,112	121,382	194,104	61[7]	319,320
CONSOLIDATED INDUSTRY								
1939[1]	142,109	8,610	.....	.....	2,713	.....	599	154,031[1]
1949[1]	863,685	61,669	.....	77,217	113,118	20,606	16,770	1,153,065
1955	2,346,717	127,630	14,821	51,280	382,866	61,781	37,114	3,022,209
1956	2,662,201	137,054	15,425	52,693	451,301	165,372	43,391	3,527,437
1957	3,011,495	143,786	16,892	46,065	507,665	229,006	49,533	4,004,442
1958	3,021,093	160,257	17,173	48,837	501,591	277,373	48,403	4,074,727

n.a. Not Available.

[1] Data not available for Alaskan airlines in 1939. All-Cargo airlines began operations in fourth quarter of 1949.
Local Service operations initiated in 1945.
Helicopter operations started in 1947, passenger service began in 1953.

[2] Express and freight combined for all carriers in 1939 and for Alaskan carriers in all years.

[3] Revenue Ton Mile data for items other than passenger ton miles for International and Overseas carriers not available for 1939, hence total does not reflect these items.

[4] Foreign mail carried by International and Overseas airlines is included in Excess Baggage. Therefore, it is also reflected in Consolidated Industry Excess Baggage data.

[5] See definitions, p. 3.

[6] Passenger ton miles for years prior to 1957 were revised to conform with "standard" passenger weights as prescribed by the CAB effective Jan. 1, 1957.
Foreign mail, Seaboard and Western.

AIRCRAFT OPERATIONS AT FAA AIRPORT TOWERS

1950-1958 (In Thousands)

Type of Flight Operation	1950	1951	1952	1953	1954	1955	1956	1957	1958
Military	2,384	2,852	2,983	3,712	4,409	4,957	5,472	5,910	5,565
General Aviation	9,585	9,618	7,965	7,719	8,015	8,540	10,021	12,129	14,037
Air Carrier	4,002	4,556	4,866	5,384	5,521	5,983	6,553	7,112	6,998
Total	15,971	17,026	15,814	16,815	17,945	19,480	22,046	25,151	26,600
% Air Carrier of Total	25.1	26.8	30.8	32.0	30.8	30.7	29.7	28.3	26.3

Air Carriers include scheduled and non scheduled operations. Each landing is counted as an operation as is also each take off.

OPERATING REVENUES

U. S. Scheduled Airline Industry

(For Selected Years, In Thousands of Dollars)

THIS TABLE SHOWS THE DOLLARS OF SALES THE SCHEDULED AIRLINES EARNED FOR THE VARIOUS SERVICES THEY RENDER

		U. S. Mail		Public Service				
	Passenger	Priority	Non-Priority	Revenue[1]	Express	Freight	Other[4]	Total
Domestic Trunk Airlines								
1939	34,484	18,436	———	———	———	1,605	1,002	55,527
1949	378,113	45,031	———	———	8,957	18,323	9,359	459,783
1955	1,021,855	24,230	2,708	3,192	19,405	39,605	22,353	1,133,348
1956	1,142,197	28,937	2,654	2,609	18,101	42,173	26,160	1,262,831
1957	1,287,172	31,002	2,760	1,182	14,667	49,870	32,961	1,419,614
1958 [p]	1,362,791	33,052	3,076	2,373	16,096	57,336	38,295	1,513,019
Local Service Airlines[2]								
1939	———	———	———	———	———	———	———	———
1949	7,362	13,533	———	———	114	138	271	21,418
1955	32,840	1,084	101	20,923	665	556	1,281	57,450
1956	40,166	1,004	102	23,211	775	750	1,704	67,712
1957	47,464	1,108	103	29,651	725	1,049	2,039	82,139
1958 [p]	56,421	1,254	116	32,523	796	1,183	2,361	94,654
Territorial Airlines								
1939	359	45	———	———	———	14[3]	3	421
1949	3,799	247	———	———	145	333	254	4,778
1955	5,686	48	———	291	———	752	337	7,114
1956	6,042	51	1	288	———	782	266	7,430
1957	6,975	51	2	72	———	781	479	8,360
1958 [p]	7,066	55	———	109	———	819	1,347	9,396
Helicopter Airlines[3]								
1939	———	———	———	———	———	———	———	———
1949	———	522	———	———	———	———	———	522
1955	208	250	———	2,710	100	23	64	3,355
1956	438	234	———	2,833	115	28	63	3,711
1957	968	237	———	3,567	101	36	123	5,032
1958 [p]	1,460	214	———	4,091	102	31	117	6,015

See Footnotes at Bottom of Page 110

Operating Revenues
(continued)

International and Overseas Airlines	Passenger	U. S. Mail Priority	U. S. Mail Non-Priority	Public Service Revenue[1]	Express	Freight	Other[4]	Total
1939	6,156	11,066	.....	.....	.....	613	1,818	19,653
1949	158,480	75,197	.....	.....	20,023	2,105	18,350	274,155
1955	294,828	25,639	.....	1,583	77	31,853	30,324	384,304
1956	342,553	26,926	.....	8,308	82	36,683	38,113	452,665
1957	377,655	28,365	.....	555	80	41,475	39,818	487,948
1958 p	386,084	32,655	.....	.....	147	43,708	43,963	506,557
Alaskan Airlines[2]								
1939	.....	.....	.....	.....	.....	.....	.....	.....
1949	2,188	2,122	.....	.....	.....	547[3]	3,639	8,496
1955	8,162	2,333	.....	5,618	.....	2,464	3,747	22,324
1956	10,200	2,477	.....	6,241	.....	2,754	7,680	29,352
1957	11,263	2,662	.....	6,369	.....	2,651	4,063	27,008
1958 p	12,522	2,918	.....	6,854	.....	2,701	3,925	28,920
All-Cargo Airlines[2]								
1939	.....	.....	.....	.....	.....	.....	.....	.....
1949	.....	.....	.....	.....	.....	1,810	300	2,110
1955	.....	60	.....	.....	.....	18,640	8,335	27,035
1956	.....	144	220	.....	447	25,564	26,485	52,860
1957	.....	189	263	.....	545	29,281	55,050	85,328
1958 p	.....	486	89	.....	300	23,171	54,862	78,908
CONSOLIDATED INDUSTRY[5]								
1939	40,999	29,547	.....	.....	.....	2,232[3]	2,823	75,601
1949	549,942	136,652	.....	.....	29,239	23,256	32,173	771,262
1955	1,363,579	53,644	2,809	34,317	20,247	93,893	66,441	1,634,930
1956	1,541,596	59,773	2,977	43,490	19,520	108,734	100,471	1,876,561
1957	1,731,497	63,614	3,128	41,396	16,118	125,143	134,533	2,115,429
1958 p [5]	1,826,344	70,634	3,281	45,950	17,441	128,949	144,870	2,237,469

p Preliminary.

[1] Prior to October 1, 1953, public service revenues were not reported separately.

[2] Local Service operations were initiated in 1945; Helicopter operations in 1947; and All-Cargo airlines in the Fourth quarter of 1949. Data not available for Alaskan Airlines in 1939.

[3] Express and Freight revenues are combined for the Territorial and the Alaskan carriers. They are reflected in freight totals.

[4] Other revenues include revenues from excess baggage and from charter operations, and incidental revenues.

[5] Revenues included for Seaboard and Western are for the twelve months ended September 30, 1958.

DISTRIBUTION OF OPERATING EXPENSES

U. S. Scheduled Airline Industry

(For Selected Years, In Thousands of Dollars)

THIS TABLE SHOWS HOW THE AIRLINES SPEND THEIR DOLLARS TO INSURE FAST, SAFE, ECONOMICAL FLYING OPERATIONS AND EFFICIENT PASSENGER AND CARGO HANDLING

Explanation of New Classification of Operating Expenses

The classification of operating expenses is different from that used in prior years. Owing to a revision of the form on which the carriers report to CAB it is not feasible to bring forward beyond 1956 the expense tables previously published in Facts and Figures. For this reason the data shown herein for years prior to 1956 were recast for this publication into the format of the new reporting system—insofar as it was feasible to do so. The data shown for 1957 and 1958 are as reported by the carriers. Although the "matching" of prior years' data with 1957 and 1958 is not perfect, it is considered adequate for general use where precision is not required.

The classifications of expenses employed in past issues of "Facts and Figures" were grouped as follows to fit the new format:

NEW CLASSIFICATION	OLD CLASSIFICATION
Flying operations	Flying operations
Maintenance	Direct maintenance—flight equipment Ground and indirect maintenance
Passenger service	Passenger service
Aircraft and traffic servicing	Ground operations
Promotion and sales	Traffic and sales Advertising and publicity
General and administrative	General and administrative
Depreciation and amortization	Depreciation—flight equipment Depreciation—ground equipment

As pointed out above, this method of matching accounts is not perfect. The figures for 1957 and 1958 differ in the following respects from those shown for 1956 and earlier:

1) "Amortization of other deferred charges," dispersed throughout the accounts for 1956 and before, is grouped in "Depreciation and amortization" after 1956.

2) "Legal fees and expenses," dispersed in several accounts prior to 1957 is all in "General and administrative."

3) Payroll taxes and employee welfare insurance, included in "General and administrative" before 1957 are distributed to other appropriate accounts.

4) Airport ticket office expenses, included in "Promotion and Sales" for earlier years is under "Aircraft and Traffic Servicing."

5) Route extension and development expenses, not classified as operating expense in prior years, are included in "Depreciation and Amortization," after 1956.

	Flying Operations	Maintenance	General Services & Administration: Passenger Service	Aircraft & Traffic Servicing	Promotion & Sales	Administrative	Total G. S. & A.	Depreciation & Amortization	Total Operating Expenses
Domestic Trunk Airlines									
1939	15,682	8,191	1,844	8,934	6,205	4,011	20,994	5,667	50,941[1]
1949	119,961	83,674	27,778	66,623	59,195	30,894	184,490	47,033	435,157
1955	302,591	196,320	72,996	133,274	134,706	68,473	409,449	101,709	1,010,069
1956	340,670	239,530	83,953	152,928	159,366	79,462	475,709	106,321	1,162,230
1957	434,842	270,328	95,505	217,208	157,561	55,164	525,438	146,968	1,377,576
1958[p]	436,953	285,564	101,361	230,846	165,772	58,182	556,161	139,808	1,418,486

See Footnotes at Bottom of Page 113

Distribution of Operating Expenses *(continued)*

	Flying Operations	Maintenance	General Services & Administration: Passenger Service	Aircraft & Traffic Servicing	Promotion & Sales	Administrative	Total G. S. & A.	Depreciation & Amortization	Total Operating Expenses
Local Service Airlines									
1939[1]	.....	.....	.....	.....	.....	.....	.....	.....	.....
1949	6,336	4,537	825	3,743	2,405	1,792	8,765	2,233	21,871
1955	18,080	10,384	2,687	9,563	9,287	4,485	26,022	2,278	56,764
1956	21,616	12,610	3,385	11,187	11,399	5,382	31,353	2,714	68,293
1957	26,509	16,418	4,028	21,160	6,089	4,938	36,215	3,758	82,900
1958[p]	29,265	18,686	4,527	24,023	6,998	5,530	41,078	4,274	93,303
Territorial Airlines									
1939	127	90	1	38	34	65	138	96	451
1949	1,091	900	165	922	628	682	2,397	444	4,832
1955	1,942	1,278	245	1,258	1,045	964	3,512	603	7,335
1956	2,033	1,259	252	1,317	1,182	848	3,599	416	7,307
1957	2,212	1,422	278	1,521	1,265	868	3,932	515	8,081
1958[p]	2,502	1,699	414	1,672	1,283	1,025	4,394	659	9,254
Helicopter Airlines									
1939[1]	.....	.....	.....	.....	.....	.....	.....	.....	.....
1949	151	133	.....	50	2	63	115	111	510
1955	614	871	21	425	180	393	1,019	451	2,955
1956	697	981	21	544	312	496	1,373	605	3,656
1957	1,108	1,381	.....	.....	.....	.....	1,765[2]	911	5,164
1958[p]	1,410	1,646	.....	.....	.....	.....	1,972[2]	948	5,976
International & Overseas Airlines									
1939	.....	.....	.....	.....	.....	.....	.....	.....	17,266[3]
1949	72,347	47,245	14,617	33,168	35,731	22,600	106,116	27,155	252,863
1955	108,501	58,975	26,773	46,990	61,980	31,291	167,034	31,094	365,604
1956	125,613	72,069	31,053	51,583	70,822	33,808	187,266	34,593	419,541
1957	142,944	72,326	32,519	67,187	70,902	24,631	195,239	50,359	460,868
1958[p]	154,912	79,904	35,527	72,550	75,802	24,878	211,138	50,694	496,648

See Footnotes at Bottom of Page 113

Distribution of Operating Expenses *(continued)*

	Flying Operations	Maintenance	General Services & Administration: Passenger Service	Aircraft & Traffic Servicing	Promotion & Sales	Administrative	Total G. S. & A.	Depreciation & Amortization	Total Operating Expenses
Alaskan Airlines									
1939[1]	.....	.....	.....	.....	.....	.....	.....	.....	.....
1949	3,440	2,343	370	988	714	1,180	3,252	1,143	10,178
1955	7,191	5,273	773	2,701	1,593	1,519	6,586	1,120	21,706[4]
1956	9,959	5,744	964	3,702	1,831	1,894	8,391	1,364	27,166[4]
1957	8,669	6,215	854	2,779	1,042	853	10,065[4]	1,646	26,595
1958[p]	8,998	6,383	921	3,281	1,067	1,185	10,626[4]	1,914	27,921
All-Cargo Airlines									
1939[1]	.....	.....	.....	.....	.....	.....	.....	.....	.....
1949	966	367	.....	206	453	215	874	74	2,281
1955	10,635	5,287	267	3,896	2,081	2,103	8,347	2,074	26,343
1956	21,677	11,662	1,614	6,353	3,883	3,454	15,304	3,155	53,879[4]
1957	36,563	18,969	3,618	12,450	4,064	4,395	25,203[4]	8,998	89,734
1958[p,4]	32,820	18,448	2,697	8,887	2,661	4,251	19,241[4]	9,445	79,954
CONSOLIDATED INDUSTRY									
1939[1]	15,809	8,281	1,345	8,972	6,239	4,076	21,132	5,763	68,658[5]
1949	204,292	139,199	43,755	105,700	99,127	57,426	306,008	78,193	727,692
1955	449,554	278,388	103,762	198,107	210,872	109,228	621,969	139,329	1,490,776[4]
1956	522,265	343,855	121,242	227,614	248,795	125,344	722,995	149,168	1,742,072[4]
1957	652,847	387,060	136,802	322,305	240,923	90,848	797,855[4]	213,156	2,050,918
1958[p,4]	666,860	412,330	145,447	341,259	253,583	95,051	844,610[4]	207,742	2,131,542

[1] Data not available for Alaskan airlines in 1939. All-Cargo airlines began certificated operations in fourth quarter of 1949. Local Service Operations initiated in 1945. Helicopter operations started in 1947.
[2] Colonial airlines included in the trunkline total for 1939 but not in the detail.
[3] Detailed expense data not available.
[4] Total is greater than sum of individual expense categories since segregation of expenses is not reported by some classes of carriers.
[5] Total for 1939 includes international carriers, not included in the detail. See note 3.
[6] Data included for Seaboard and Western are for the 12 months ended Sept. 30, 1958.
[p] Preliminary.

SUMMARY OF PROFIT OR LOSS

U. S. Scheduled Airline Industry

(For Selected Years, In Thousands of Dollars)

THIS TABLE SHOWS THE EARNINGS OF AIRLINES WHICH WERE AVAILABLE FOR DIVIDENDS TO STOCKHOLDERS OR FOR RETENTION IN THE BUSINESS. IT ALSO SHOWS THESE DOLLARS AS A PER CENT OF SALES AND THE RATIO OF TOTAL RETURN TO INVESTMENT

	Total Operating Revenues	Total Operating Expenses	Net Operating Income	Interest on Long-Term Debt	Other Non-Operating Income (Net)	Income Taxes	Net Profit or Loss[3]	Rate of Return on Investment[3] (%)	Profit Margin on Sales[4] (%)
Domestic Trunk Airlines									
1939	55,527	50,941	4,586	n.a.	n.a.	n.a.	n.a.	.....	.....
1949	459,783	435,157	24,626	4,466	503	7,285	13,378	.....	.....
1955	1,133,348	1,010,069	123,279	6,540	16,388	70,024	63,103	11.8	5.6
1956	1,262,831	1,162,230	100.601	9,964	23,917	56,842	57,712	9.4	4.6
1957	1,419,614	1,377,576	42,036	16,201	18,651	23,076	26,988	4.9	1.9
1958 p	1,513,019	1,418,486	94,533	24,309	19,859	43,842	44,709	6.6	3.0
Local Service Airlines[1]									
1939	.....	.....	.....	.....	.....	.....	.....	.....	.....
1949	21,418	21,871	(453)	80	(749)	168	(1,451)	.....	.....
1955	57,450	56,764	686	219	369	484	352	2.7	0.6
1956	67,712	68,293	(581)	376	106	(50)	(801)	(—)	(—)
1957	82,139	82,900	(760)	224	(472)	(51)	(1,153)	(—)	(—)
1958 p	94,654	93,303	1,351	824	282	348	2,306	15.5	2.4
Territorial Airlines									
1939	421	451	(30)	n.a.	n.a.	n.a.	n.a.	.....	.....
1949	4,778	4,832	(54)	9	(69)	57	(189)	.....	.....
1955	7,114	7,335	(221)	106	210	8	(125)	(—)	(—)
1956	7,430	7,307	123	97	(14)	.....	12	3.3	0.2
1957	8,360	8,081	278	109	376	53	267	11.0	3.2
1958 p	9,396	9,254	142	163	(48)	1	(70)	4.3	(—)
Helicopter Airlines[1]									
1939	.....	.....	.....	.....	.....	.....	.....	.....	.....
1949	522	510	12	.....	(28)	.....	(16)	.....	.....
1955	3,355	2,955	400	11	155	202	342	10.0	10.2
1956	3,711	3,656	55	23	(63)	8	(39)	(—)	(—)
1957	5,032	5,164	(131)	64	19	(55)	(111)	(—)	(—)
1958 p	6,015	5,976	39	96	19	(8)	(30)	1.3	(—)

See Footnotes at Bottom of Page 115

Summary of Profit or Loss
(continued)

	Total Operating Revenues	Total Operating Expenses	Net Operating Income	Interest on Long-Term Debt	Other Non-Operating Income (Net)	Income Taxes	Net Profit or Loss[2]	Rate of Return on Investment[3] (%)	Profit Margin on Sales[4] (%)
International and Overseas Airlines									
1939	19,653	17,266	2,387	n.a.	n.a.	n.a.	n.a.	.....	.....
1949	274,155	252,863	21,292	736	(11,740)	1,362	7,454	.....	.....
1955	384,304	365,604	18,700	1,700	..6,754	10,320	13,434	6.3	3.5
1956	452,665	419,541	33,124	3,000	8,169	17,792	20,501	8.2	4.5
1957	487,665	419,541	33,124	3,000	8,619	13,252	19,520	7.8	4.0
1958 p	506,557	496,648	9,909	5,792	7,300	5,441	6,793	3.7	1.3
Alaskan Airlines [1]									
1939	.....	.....	.....	.....	.....	.....	.....	.....	.....
1949	8,496	10,178	(1,682)	38	(97)	28	(1,789)	.....	.....
1955	22,324	21,706	518	76	228	334	436	8.3	2.0
1956	29,352	27,166	2,186	222	(98)	870	996	15.1	3.4
1957	27,008	26,595	413	362	729	121	900	11.1	3.3
1958 p	28,920	27,921	999	415	355	631	882	9.6	3.0
All-Cargo Airlines [1]									
1939	.....	.....	.....	.....	.....	.....	.....	.....	.....
1949	2,110	2,281	(171)	.....	18	2	(155)	.....	.....
1955	27,035	26,343	692	561	1,132	80	1,163	9.4	4.4
1956	52,860	53,879	(1,019)	488	4,539	1,210	1,822	7.0	3.4
1957	85,328	89,734	(4,406)	1,526	4,022	285	(2,207)	(—)	(—)
1958 p	78,908	79,954	(1,046)	1,669	(212)	2,335	(1,676)	(—)	(—)
CONSOLIDATED INDUSTRY									
1939	75,601	68,658	6,943	n.a.	n.a.	n.a.	n.a.	.....	.....
1949	771,262	727,692	43,570	5,329	(12,106)	8,902	17,235	.....	.....
1955	1,634,930	1,490,776	144,154	9,213	25,236	81,452	78,725	10.8	4.8
1956	1,876,561	1,742,072	134,489	14,170	36,556	76,672	80,203	8.8	4.3
1957	2,115,429	2,050,918	64,511	23,368	31,665	36,683	44,202	5.1	2.1
1958 p [5]	2,237,469	2,131,542	105,927	33,268	27,555	52,590	52,914	5.8	2.4

n.a. Not Available.

[1] Data not available for Alaskan airlines in 1939. All-Cargo airlines began operations in fourth quarter of 1949. Local Service operations initiated in 1945. Helicopter operations started in 1947.

[2] Net profit or loss for 1957 and 1958 is shown after "Special Items," which are not included in the detail. Therefore, the items do not add to the profit figures shown.

[3] Net income before interest and after taxes as percent of average net worth and long-term debt.

[4] Profit as percent of revenues.

[5] Data for Seaboard and Western are for the 12 months ended Sept. 30, 1958.

p Preliminary.

ASSETS, LIABILITIES AND STOCKHOLDERS' EQUITY

U. S. Scheduled Airline Industry

(As of Dec. 31, for Selected Years, In Thousands of Dollars)

THIS TABLE SHOWS WHAT THE SCHEDULED AIRLINES OWN AND WHAT THEY OWE

	1939	1949	1955	1956	1957	(Sept. 30) 1958
Domestic Trunk Airlines[b]						
Assets						
Current Assets	23,592	175,471	436,609	439,827	457,611	456,748
Investments and Special Funds	2,585	41,370	47,405	146,147	127,943	163,496
Flight Equipment		329,915	890,095	1,097,044	1,363,767	1,489,783
Reserve for Depreciation and Maintenance		141,296	478,482	553,793	639,019	719,249
Ground Property and Equipment	17,412a	91,837	154,104	180,613	206,452	223,809
Reserve for Depreciation		35,271	77,622	89,217	101,001	112,489
Other Property		7,618	28,402	41,359	49,667	77,549
Deferred Charges	1,754	15,658	9,459	13,264	23,541	28,247
Other Assets	708	1,640	1,175	6,308	.....	.....
Total Assets	46,051	486,942	1,011,145	1,281,552	1,488,961	1,607,894
Liabilities and Equity						
Current Liabilities	9,316	98,428	276,839	333,876	328,844	322,098
Long-Term Debt	4,002	148,017	198,916	324,071	469,486	534,644
Other Non-Current Liabilities	.....	.....	.....	.....	1,224	19,582
Operating Reserves	257	3,636	8,365	10,490	.....	.....
Deferred Credits	721	12,724	22,886	37,646	51,480	75,288
Stockholders' Equity—Net of Treasury Stock	31,755	224,137	504,139	575,469	637,927	656,282
Preferred Stock	621	60,827	29,789	16,592	15,805	14,434
Common Stock	21,385	62,884	80,172	88,555	108,502	109,896
Other Paid-In Capital	12,903	63,434	141,839	178,058	215,292	221,383
Retained Earnings	(3,154)	36,992	252,339	291,872	298,328	310,569
Total Liabilities and Equity	46,051	486,942	1,011,145	1,281,552	1,488,961	1,607,894
Local Service Airlines						
Assets						
Current Assets	.....	5,648	12,970	14,873	16,512	17,522
Investments and Special Funds	.....	684	950	1,438	3,028	3,358
Flight Equipment	.....	7,926	21,451	26,105	32,949	37,335
Reserve for Depreciation and Maintenance	.....	3,780	11,096	12,628	16,825	19,202
Ground Property and Equipment	.....	2,242	5,122	5,795	6,544	7,035
Reserve for Depreciation	.....	869	2,555	2,949	3,556	4,080
Other Property	.....	321	682	3,692	607	1,620
Deferred Charges	.....	2,007	885	1,564	1,931	2,141
Other Assets	.....	75	2	35	.....	.....
Total Assets	.....	14,254	28,411	37,925	41,190	45,729
Liabilities and Equity						
Current Liabilities	.....	4,449	12,461	17,431	22,002	23,627
Long-Term Debt	.....	1,578	4,013	7,800	8,656	9,733
Other Non-Current Liabilities	.....	.....	.....	.....	205	349
Operating Reserves	.....	170	783	1,138	.....	.....
Deferred Credits	.....	100	21	303	264	198
Stockholders' Equity—Net of Treasury Stock	.....	7,957	11,133	11,253	10,063	11,822
Preferred Stock	.....	226	412	920	163	163
Common Stock	.....	5,191	6,345	5,871	6,776	7,359
Other Paid-In Capital	.....	4,265	4,324	4,891	4,863	5,669
Retained Earnings	.....	(1,725)	52	(429)	(1,739)	(1,369)
Total Liabilities and Equity	.....	14,254	28,411	37,925	41,190	45,729

a. Net property and equipment.
b. Balance sheet data for domestic trunk airlines reflect their international as well as domestic operations.

Assets, Liabilities and Stockholders' Equity *(continued)*

	1939	1949	1955	1956	1957	(Sept. 30) 1958
Territorial Airlines						
Assets						
Current Assets	100	1,333	1,068	1,241	1,964	2,246
Investments and Special Funds	72	272	19	15	113	21
Flight Equipment		2,220	5,744	6,057	5,932	7,751
Reserve for Depreciation and Maintenance		1,331	2,839	2,930	3,230	3,646
Ground Property and Equipment	333a	963	1,177	1,276	1,354	1,481
Reserve for Depreciation		528	749	847	945	1,025
Other Property		132	41	17	133	59
Deferred Charges	38	156	180	169	182	358
Other Assets	.....	25	.....	.....	.....	.....
Total Assets	543	3,242	4,641	4,998	5,503	7,245
Liabilities and Equity						
Current Liabilities	18	763	1,329	1,520	2,011	2,399
Long-Term Debt	62	.....	1,835	1,702	1,635	2,758
Other Non-Current Liabilities	.....	.....	.....	.....	.....	.....
Operating Reserves	15	10	20	41	.....	.....
Deferred Credits	.....	81	1	68	23	17
Stockholders' Equity—Net of Treasury Stock	448	2,388	1,456	1,667	1,834	2,071
Preferred Stock	.....	.....	.....	.....	.....	.....
Common Stock	448	2,649	1,981	1,981	1,981	1,981
Other Paid-In Capital	9	132	874	832	832	832
Retained Earnings	(9)	(393)	(1,399)	(1,146)	(979)	(742)
Total Liabilities and Equity	543	3,242	4,641	4,998	5,503	7,245
Helicopter Airlines						
Assets						
Current Assets	.....	1	14	71	1	32
Investments and Special Funds	.....	138	163	196	302	503
Flight Equipment	.....	59	.....	.....	.....	.....
Reserve for Depreciation and Maintenance	.....	723	4,253	5,476	5,798	6,551
Ground Property and Equipment	.....	174	2,385	2,307	2,168	2,119
Reserve for Depreciation	.....	.....	321	290	27	52
Other Property	.....	486	2,508	3,878	5,170	4,848
Deferred Charges	.....	165	1,313	1,645	2,336	1,428
Other Assets	.....	42	312	576	777	796
Total Assets	.....	12	137	197	311	371
Liabilities and Equity						
Current Liabilities	.....	69	591	735	961	1,264
Long-Term Debt	.....	.....	87	817	1,033	1,467
Other Non-Current Liabilities	.....	.....	.....	.....	.....	1
Operating Reserves	.....	.....	31	45	.....	.....
Deferred Credits	.....	.....	25	69	109	115
Stockholders' Equity—Net of Treasury Stock	.....	654	3,519	3,810	3,695	3,704
Preferred Stock	.....	320	.....	.....	.....	.....
Common Stock	.....	375	677	702	734	771
Other Paid-In Capital	.....	.....	2,201	2,435	2,546	2,685
Retained Earnings	.....	(41)	641	673	415	248
Total Liabilities and Equity	.....	723	4,253	5,476	5,798	6,551
International and Overseas Airlines[b]						
Assets						
Current Assets	7,913	68,903	109,019	111,560	102,202	109,329
Investments and Special Funds	790	8,448	33,230	37,987	52,992	80,446
Flight Equipment		143,009	216,737	265,785	276,758	280,461
Reserve for Depreciation and Maintenance		46,837	99,787	114,074	132,185	146,385
Ground Property and Equipment	16,839a	22,649	29,595	31,813	34,351	35,278
Reserve for Depreciation		10,730	18,424	18,614	20,741	22,396
Other Property		2,536	2,719	2,450	4,239	7,095
Deferred Charges	327	25,276	3,766	4,440	4,413	6,193
Other Assets	4,486	.....	.....	.....	.....	.....
Total Assets	30,355	213,254	276,855	321,347	322,029	350,021

(International and Overseas Airlines continued on next page)

See Footnotes at Bottom of Page 116

Assets, Liabilities and Stockholders' Equity *(continued)*

	1939	1949	1955	1956	1957	1958 (Sept. 30)
International and Overseas Airlines						
Liabilities and Equity						
Current Liabilities	6,169	32,483	80,041	92,352	87,424	106,621
Long-Term Debt	2,115	43,307	60,481	83,406	85,653	92,688
Other Non-Current Liabilities	767	.....	.....	.....	1,011	880
Operating Reserves	.....	5,333	3,319	3,584	.....	.....
Deferred Credits	527	18,407	5,846	6,058	6,648	7,123
Stockholders' Equity—Net of Treasury Stock	20,777	113,724	127,168	135,947	141,293	142,709
Preferred Stock	.....	150	150	.....	.....	.....
Common Stock	7,060	12,755	13,622	13,792	16,310	16,346
Other Paid-In Capital	10,458	77,883	63,120	63,460	62,129	62,420
Total Retained Earnings	3,259	22,936	50,276	59,119	62,854	63,943
Total Liabilities and Equity	30,355	213,254	276,855	321,347	322,029	350,021
Alaskan Airlines						
Assets						
Current Assets	.....	2,408	5,600	7,129	7,682	8,819
Investments and Special Funds	.....	5	248	532	957	885
Flight Equipment	.....	4,431	6,906	11,126	13,668	15,243
Reserve for Depreciation and Maintenance	.....	2,483	4,981	5,539	6,080	6,847
Ground Property and Equipment	.....	1,407	3,808	4,201	4,843	4,877
Reserve for Depreciation	.....	544	1,531	1,808	2,138	2,335
Other Property	.....	207	163	400	313	1,102
Deferred Charges	.....	348	358	422	624	774
Other Assets	.....	214	138	134	.....	.....
Total Assets	.....	5,993	10,709	16,597	19,869	22,518
Liabilities and Equity						
Current Liabilities	.....	2,530	4,002	6,170	7,084	7,939
Long-Term Debt	.....	491	765	3,360	4,942	5,938
Other Non-Current Liabilities	.....	.....	.....	.....	25	42
Operating Reserves	.....	141	457	276	.....	.....
Deferred Credits	.....	65	200	42	104	209
Stockholders' Equity—Net of Treasury Stock	.....	2,766	5,285	6,749	7,714	8,390
Preferred Stock	.....	7	.....	.....	.....	279
Common Stock	.....	2,151	2,950	3,152	3,315	3,497
Other Paid-In Capital	.....	2,917	3,605	3,613	3,629	3,622
Retained Earnings	.....	(2,309)	(1,270)	(16)	770	992
Total Liabilities and Equity	.....	5,993	10,709	16,597	19,869	22,518
All-Cargo Airlines						
Assets						
Current Assets	.....	2,600	11,716	21,224	19,589	22,581
Investments and Special Funds	.....	53	2,850	17,244	4,629	3,714
Flight Equipment	.....	2,293	24,143	31,540	65,449	59,989
Reserve for Depreciation and Maintenance	.....	589	7,575	9,188	17,500	18,743
Ground Property and Equipment	.....	969	2,753	4,666	5,578	5,294
Reserve for Depreciation	.....	467	1,354	1,833	2,382	2,484
Other Property	.....	23	399	3,028	2,682	2,879
Deferred Charges	.....	365	410	2,706	5,122	4,940
Other Assets	.....	.....	140	281	.....	.....
Total Assets	.....	5,247	33,482	69,668	83,167	78,170
Liabilities and Equity						
Current Liabilities	.....	1,568	10,759	19,301	25,991	22,153
Long-Term Debt	.....	1,431	7,598	16,813	25,121	23,100
Other Non-Current Liabilities	.....	.....	.....	.....	449	1,312
Operating Reserves	.....	101	1,808	2,311	.....	.....
Deferred Credits	.....	17	235	2,277	3,257	3,998
Stockholders' Equity—Net of Treasury Stock	.....	2,130	13,082	28,966	28,349	27,607
Preferred Stock	.....	.....	1,211	1,441	1,437	1,436
Common Stock	.....	4,169	5,466	6,863	8,237	8,532
Other Paid-In Capital	.....	3,135	4,304	14,341	15,701	17,649
Retained Earnings	.....	(5,174	2,101	6,321	2,974	(10)
Total Liabilities and Equity	.....	5,247	33,482	69,668	83,167	78,170

See Footnotes at Bottom of Page 116

Assets, Liabilities and Stockholders' Equity
(continued)

	1939	1949	1955	1956	1957	(Sept. 30) 1958
Consolidated Industry						
Assets						
Current Assets	31,605	256,537	579,367	598,161	607,728	619,364
Investments and Special Funds	3,447	50,832	85,023	203,653	189,689	251,972
Flight Equipment		490,280	1,167,584	1,441,535	1,763,693	1,895,410
Reserve for Depreciation and Maintenance		196,481	606,073	699,797	817,175	915,500
Ground Property and Equipment	34,584a	120,109	196,871	228,940	259,899	278,570
Reserve for Depreciation		48,421	102,372	115,465	131,074	145,180
Other Property		10,838	32,420	51,017	57,642	90,336
Deferred Charges	2,119	43,948	15,221	22,761	36,115	43,156
Other Assets	5,194	2,013	1,455	6,758	.....	.....
Total Assets	76,949	729,655	1,369,496	1,737,563	1,966,517	2,118,128
Liabilities and Equity						
Current Liabilities	15,503	140,290	386,022	471,385	474,317	486,101
Long-Term Debt	6,179	194,824	273,695	437,969	596,526	670,328
Other Non-Current Liabilities	767	.....	.....	.....	2,914	22,166
Operating Reserves	272	9,391	14,783	17,885	.....	.....
Deferred Credits	1,248	31,394	29,214	46,463	61,885	86,948
Stockholders' Equity—Net of Treasury Stock	52,980	353,756	665,782	763,861	830,875	852,585
Preferred Stock	621	61,530	31,562	18,953	17,405	16,312
Common Stock	28,893	90,174	111,213	120,916	145,855	148,382
Other Paid-In Capital	23,370	151,766	220,267	267,630	304,992	314,260
Retained Earnings	96	50,286	302,740	356,394	362,623	373,631
Total Liabilities and Equity	76,949	729,655	1,369,496	1,737,563	1,966,517	2,118,128

See Footnotes at Bottom of Page 24

DOMESTIC INTERCITY PASSENGER MILES

(For Selected Years, In Millions)

	1939	1949	1955	1956	1957	1958
Railroad Travel:[1]						
First Class	7,527	9,349	6,440	6,275	5,185	4,249
Coach	11,180	20,310	17,329	17,105	16,365	14,300[5]
Air Travel:[2]						
First Class	654	6,454	13,025	14,202	15,736	15,180
Coach	.....	251	6,716	8,074	9,510	10,076
Motor Bus Travel[3]	9,100	22,411	16,562	16,409	14,886	14,588[5]
Total Common Carriers	28,461	58,775	60,072	62,065	61,682	58,393
Airline Share of Total	2.3	11.4	32.9	35.9	40.9	43.3
Private Automobile, Intercity[4]	234,700	376,313	585,800	617,700	637,800	650,000[5]
Total Common Carrier and Auto	263,161	435,088	645,872	679,765	699,482	708,393
Airline Share of Total Intercity Travel	0.2	1.5	3.1	3.3	3.6	3.6

[1] I.C.C., Statistics of Railways in the United States, 1958, Statement M-250.
[2] 1939, CAB, Annual Airline Statistics; 1949, CAB, Recurrent Reports on Traffic Statistics; 1955-1957, CAB, Monthly Reports on Air Carrier Traffic; 1958, Carrier Reports to CAB.
[3] 1939, I.C.C. Statement No. 531, Jan. 1953; 1949-1957, I.C.C., Transport Economics, Dec. 1958.
[4] 1939, NAMBO, Bus Facts, 20th Edition; 1949-1956, I.C.C., Transport Economics, May 1956; 1958 estimated on basis of gasoline sales.
[5] Estimated.

REVENUE PASSENGERS CARRIED

U. S. Scheduled Airline Industry

(For Selected Years, In Thousands of Passengers)

	1939	1949	1951	1952	1953	1954	1955	1956	1957[2]	1958[2]
Domestic Trunk Airlines	1,713	14,021	20,621	22,759	26,137	29,526	34,511	37,598	40,270	39,513
Local Service Airlines	.....	678	1,481	1,736	2,032	2,423	2,897	3,453	3,943	4,265
Territorial Airlines	22	382	550	515	553	561	591	627	589	572
Helicopter Airlines	.....	.....	.....	.....	1	9	29	62	148	228
International and Overseas Airlines	129	1,520	2,038	2,362	2,682	2,888	3,376	3,888	4,065	4,182
Alaskan Airlines[1]	n.a.	122	157	194	220	225	264	315	309	315
TOTAL SCHEDULED AIRLINE INDUSTRY	1,864	16,723	24,847	27,566	31,625	35,632	41,623	45,943	49,339	49,075
AVERAGE LENGTH OF HAUL (Statute Miles)										
Domestic Trunk Airlines	397	469	495	533	547	550	557	576	608	618
International and Overseas Airlines	557	1,351	1,275	1,278	1,261	1,296	1,307	1,315	1,415	1,429

[1] Alaskan data for 1949 include charter flights. 1939 not available.

[2] Passengers for 1957 and 1958 were reported on a basis which yielded slightly lower figures than the basis used in prior years. This accounts in part for the typical increase of average length of haul in 1957 as compared to 1956.

AVERAGE REVENUE PER PASSENGER MILE

Intercity Common Carriers

(For Selected Years, In Cents per Mile)

	1939	1946	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958
Domestic Scheduled Airlines[1]												
Coach or Toursist	.....	.....	3.96	4.10	4.45	4.18	4.13	4.34	4.32	4.29	4.25	4.52
All Services	5.28	4.62	5.75	5.54	5.59	5.54	5.43	5.37	5.32	5.28	5.25	5.58
International Scheduled Airlines												
Coach or Toursist	.....	.....	.....	.....	.....	.....	5.77	5.83	n.a.	n.a.	5.77	5.66
All Services	8.57	8.31	7.72	7.28	7.13	7.04	6.88	6.79	6.68	6.70	6.57	6.52
Railroads, Class I[4]												
First Class[3]	2.33	2.45	3.14	3.25	3.27	3.35	3.38	3.35	3.31	3.39	3.68	3.72
Coach	1.80	1.82	2.41	2.47	2.47	2.53	2.53	2.50	2.47	2.56	2.71	2.75
Intercity Motor Buses, Class I	1.56	1.66	1.84	1.88	1.94	2.02	2.05	2.07	2.05	2.13	2.26	2.37[2]

[1] Trunk airlines.

[2] Estimated.

[3] Does not include payments to Pullman Company for seat, berth, etc.

[4] Excludes commutation.

n.a. Not available.

Note: Average passenger fare is derived by dividing passenger revenue by revenue passenger miles.

AIRCRAFT OWNED AND ON ORDER

By U. S. Scheduled Airline Industry
(For Selected Years)

THIS TABLE SHOWS HOW THE SIZE AND TYPE OF AIRCRAFT USED BY THE SCHEDULED AIRLINES HAS IMPROVED OVER THE YEARS AND HOW THE SCHEDULED AIRLINES WILL CONTINUE TO ADD NEW AND FASTER AIRCRAFT TO INSURE IMPROVED SERVICE FOR THEIR CUSTOMERS.

Manufacturer	Model	1939	1949	1952	1956	(Jan.)[1] 1959	New aircraft on order for delivery in: 1959	1960	1961
Boeing:	247D, 307B, 314	45	5	—	—	—	—	—	—
	377	—	35	44	34	32	—	—	—
	B707 (Jet)	—	—	—	—	9	36	10	—
	B707-Intercontinental (Jet)	—	—	—	—	—	12	23	—
	B720 (Jet)	—	—	—	—	—	—	26	10
Convair:	240	—	112	113	100	76	—	—	—
	340	—	—	8	123	113	—	—	—
	440	—	—	—	19	31	—	—	—
	600 (Jet)	—	—	—	—	—	—	—	25[2]
	880 (Jet)	—	—	—	—	—	2	38	10
Curtiss:	C-46	—	2	75	94	87	—	—	—
Douglas:	DC-2	56	—	—	—	—	—	—	—
	DC-3	147	449	419	356	331	—	—	—
	DC-4	—	230	185	143	95	—	—	—
	DC-6	—	109	195	299	364	—	—	—
	DC-7	—	—	—	132	252	—	—	—
	DC-8 (Jet)	—	—	—	—	—	19	67	15
Fairchild:	F-27 (Turboprop)	—	—	—	—	21	18	—	—
Lockheed:	L-10	41	6	—	—	—	—	—	—
	Lodestar	—	11	11	10	7	—	—	—
	Other early models	6	—	—	—	—	—	—	—
	Constellation	—	79	115	117	112	—	—	—
	Super Constellation	—	—	24	79	140	—	—	—
	Electra (Turboprop)	—	—	—	—	11	89	26	—
Martin:	202	—	24	21	23	26	—	—	—
	404	—	—	96	97	95	—	—	—
Sikorsky:	All types	28	—	—	—	—	—	—	—
Vickers:	V-700 (Series) (Turboprop)	—	—	—	54	70	—	—	—
	V-800 (Series) (Turboprop)	—	—	—	—	12	3	—	—
Other		24	10	17	25	18	—	—	—
Total Fixed Wing		347	1,072	1,323	1,705	1,902	179	190	60
Helicopters:									
Bell:	B47	—	6	6	7	4	—	—	—
Sikorsky:	S51	—	5	3	2	2	—	—	—
	S55	—	—	5	8	6	—	—	—
	S58	—	—	—	3	5	—	—	—
	V44B	—	—	—	—	5	—	—	—
Total Helicopters		—	11	14	20	22	—	—	—

[1] Piston powered aircraft data are as of January 14 and turbine as of January 31, 1959.
[2] Ten scheduled for delivery in 1961 and 15 in 1962.

COMPARATIVE TRANSPORT SAFETY RECORD

Passenger Fatality Rate per 100,000,000 Passenger Miles
(For Selected Years)

	1939	1949	1951	1952	1953	1954	1955	1956	1957	1958
Domestic Scheduled Airlines										
Fatalities	9	93	142	46	86	16	156	143	30	113
Rate	1.20	1.39	1.35	.37	.59	.10	.79	.64	.12	.45
International and Overseas Scheduled Airlines [1]										
Fatalities	10	4	43	94	2	0	2	9	40	11
Rate	12.80	.19	1.59	2.98	.06	.....	.04	.17	.67	.18
Motor Buses										
Fatalities	[3]	120	130	100	70	60	100	80	70	n.a.
Rate	[3]	.19	.22	.16	.13	.11	.19	.16	.13	n.a.
Railroad Passenger Trains										
Fatalities	32	29	150	14	50	23	19	57	17	61[2]
Rate	.14	.08	.43	.04	.16	.08	.07	.20	.07	.26[2]
Passenger Autos and Taxis										
Fatalities	16,300	15,300	21,000	22,600	23,500	22,500	24,700	26,100	25,700	n.a.
Rate	3.7	2.0	2.4	2.8	2.9	2.6	2.7	2.7	2.6	n.a.

[1] Alaska data not included in 1939.
[2] Preliminary.
[3] Motor Bus statistics included in Passenger Autos and Taxis.
n.a. Not Available.

COMPARISON OF RAIL AND AIR FARES WITH TRAVEL TIMES

(1949 and 1958)

FARES

	First Class						Coach					
	Rail[a]			Air			Rail			Air		
	1949	1958	% Change	1949	1958	% Change	1949	1958	% Change	1949	1958	% Change
Chicago—New York	$ 39.55	$ 74.35[b]	88.0	$ 44.10	$ 47.95	8.7	$22.75	$37.33	64.1	$29.60	$ 34.10	15.2
Detroit—Boston	32.54	51.21[b]	57.4	38.70	42.30	9.3	19.88	31.03	56.1	.....	32.35	.....
Los Angeles—New York	132.90	163.50	23.0	157.85	166.25	5.3	71.42	92.91	30.1	.....	104.00	.....
Washington—New Orleans	49.73	61.59	23.8	62.95	67.55	7.3	28.32	34.49	21.8	45.70	45.00	—1.5
Dallas—San Francisco	79.56	91.06	14.5	96.35	102.85	6.7	42.88	50.65	18.1	.....	70.70	.....
Minneapolis—Seattle	76.56	87.84	14.7	97.25	103.20	6.1	43.45	47.90	10.2	.....	75.75	.....
Cincinnati—Miami	51.66	64.95	25.7	62.50	68.10	9.0	29.29	36.46	24.5	.....	42.95	.....
Philadelphia—Atlanta	35.19	47.83	35.9	44.25	48.10	8.7	20.00	24.92	24.6	.....	30.35	.....

TRAVEL TIMES

	Rail			Air		
	1949	1958	% Change	1949	1958	% Change
Chicago—New York	15:30	15:30	0.0	2:55	2:25	—17.1
Detroit—Boston	14:50	13:35	—8.4	3:10	2:35	—18.6
Los Angeles—New York	66:00	63:50	—3.3	9:45	7:20	—24.8
Washington—New Orleans	27:00	25:20	—6.2	3:15	3:05	— 5.2
Dallas—San Francisco	47:10	44:15	—5.9	5:20	4:45	—10.9
Minneapolis—Seattle	37:15	36:10	—2.9	7:25	5:20	—28.2
Cincinnati—Miami	33:05	31:45	—4.0	6:18	3:12	—49.2
Philadelphia—Atlanta	15:47	15:08	—4.1	5:26	2:58	—45.3

[a] Includes price of a lower berth.
[b] Roomettes sustituted for lower berth, when no berth charge is shown on timetable.

CLASSES OF UNITED STATES COMMERCIAL AIR CARRIERS

At the end of 1958 there were seven recognized classes of air carriers in the air transport industry of the United States. These classifications are used by the Civil Aeronautics Board in connection with the economic regulation of the industry and under the Civil Aeronautics Act are based largely on the scope of operations authorized or allowed by that Act. Classes One to Six have certificates of convenience and necessity and conduct regularly scheduled services.

1. The Domestic Trunk Lines include those carriers which presently have permanent operating rights within the continental United States. There are currently twelve trunk lines, most of which operate high-density traffic routes between the principal traffic centers of the United States.

American	Continental	National	Trans World
Braniff	Delta	Northeast	United
Capital	Eastern	Northwest	Western

2. The Domestic Local Service Lines have, with one exception, been certificated since 1945. These carriers operate routes of lesser traffic density between the smaller traffic centers and between these centers and principal centers. The thirteen local service lines in 1958 were:

Allegheny	Lake Central	Ozark	Southern
Bonanza	Mohawk	Pacific	Trans Texas
Central	North Central	Piedmont	West Coast
Frontier			

3. The International and Overseas Lines include all U. S. flag air carriers operating between the United States and foreign countries other than Canada. Some of these carriers conduct operations between foreign countries and some are extensions of domestic trunk lines into Mexico and the Caribbean.

Alaska	Eastern	Pan American	Trans Caribbean [2]
American	Mackey [2]	Pan American-Grace	Trans World
Braniff	National	Resort [1 2]	U. M. C. A. [2]
Caribbean Atlantic	Northwest	Samoan [2 3]	United
Delta	Pacific Northern	South Pacific [2 3]	Western

4. The Territorial Lines include two groups of carriers. The Insular Lines operate in the Hawaiian Islands and the Alaskan Lines operate between the U. S. and Alaska and within Alaska.

INSULAR LINES	ALASKAN LINES			
	Operating between the U. S. and Alaska		Operators within Alaska	
Hawaiian	Alaska [4]	Pacific Northern [4]	Alaska	Howard J. Mays [2]
Aloha	Northwest [5]	Pan American [5]	Alaska Coastal	Northern Consolidated
			Bristol Bay [2 3]	Pacific Northern
			Cordova	Pan American
			Ellis	Reeve Aleutian
				Wien

5. The Helicopter Airmail Lines presently operate between airports, central post offices, and suburbs of New York, Chicago and Los Angeles. Originally certificated as exclusive mail carriers they now fly passengers, air freight and air express.

Chicago Helicopter Airways	Los Angeles Airways	New York Airways

6. The All-Cargo Lines operate under temporary certificates authorizing scheduled cargo flights between designated areas in the U. S., and in one case to the Caribbean and in another to Europe.

AAXICO	Flying Tigers	Seaboard & Western
Aerovias Sud Americana	Riddle	Slick

7. Non-Certificated Air Carriers include a diversified group of operators who, with the exception of the air taxi operators and air freight forwarders, are not authorized to engage in regularly scheduled service. They are described in the CAB 1954 Annual Report as follows:

Operators of various types of air services have been authorized by the Board through the exemption process, rather than through the requirement that a certificate of convenience and necessity be obtained. As of December 31, 1958 this group includes:

Supplemental and irregular transport carriers	43
Air freight forwarders	71
Air taxi operators	2019

---

[1] Certificated cruise carrier.
[2] Certificated non-mail carriers.
[1 2 3] Statistical data of these carriers are not included in the statistical tables.
[3] Not operating.
[4] Statistical data of these carriers are included with Alaskan Airlines.
[5] Statistical data of these carriers are included with International and Overseas Airlines.

AIR TRANSPORT ASSOCIATION OF AMERICA

20TH EDITION
Facts and Figures, 1959

OFFICERS

Stuart G. Tipton, *President*
Frederic Davis, *V.P., Assistant to the President*
John Hoving, *V.P., Public Relations*
E. F. Kelly, *V.P., Finance & Accounting*
W. N. Martin, *V.P., Public Affairs*
J. L. O'Brien, *V.P., Personnel Relations*
Leo Seybold, *V.P., Federal Affairs*
Robert L. Turner, *V.P., Traffic*
John E. Stephen, *General Counsel*
F. J. Macklin, *Assistant V.P., Traffic & Director of Tariff*
John Lundmark, *Assistant V.P., Traffic*
J. D. Durand, *Secretary*
Bess Udoff, *Assistant Secretary*
J. F. Hintersehr, *Treasurer*
W. B. Becker, *Acting Director, Operations & Engineering*

DIRECTORS

C. E. Beard (Braniff)
Edmund Converse (Bonanza)
R. L. Cummings, Jr. (New York)
T. C. Drinkwater (Western)
R. E. McKaughan (Trans-Texas)
R. A. Norden (Seaboard & Western)
D. W. Nyrop (Northwest)
W. A. Patterson (United)
W. L. Pierson (Trans World)
E. V. Rickenbacker (Eastern)
C. R. Smith (American)
J. T. Trippe (Pan American)

MEMBER AIRLINES

AAXICO Airlines, *Howard J. Korth, Pres., P. O. Box 875, Miami Int'l Airport Branch, Miami, Florida*
Alaska Airlines, *Chas. F. Willis, Pres., 2320 Sixth Avenue, Seattle 1, Washington*
Alaska Coastal Airlines, *O. F. Benecke, Co-Manager, 2 Marine Way, Juneau, Alaska*
Allegheny Airlines, *Leslie O. Barnes, Pres., Washington National Airport, Washington 1, D. C.*
American Airlines, *C. R. Smith, President, 100 Park Avenue, New York 17, New York*
Bonanza Air Lines, *Edmund Converse, Pres., McCarran Field, P. O. Box 391, Las Vegas, Nevada*
Braniff Int'l Airways, *C. E. Beard, Pres., Braniff Building, Exchange Park, Dallas 35, Texas*
***Canadian Pacific Airlines,** *G. W. G. McConachie, Pres., Sea Island Airport, Vancouver AMF, B. C., Canada*
Capital Airlines, *David H. Baker, President & Chief Executive Officer, Washington National Airport, Washington 1, D. C.*
***Caribbean Atlantic Airlines,** *Dionisio Trigo, Pres., P. O. Box 6035, Loiza Street Station, Santurce, Puerto Rico*
Central Airlines, *Keith Kahle, Pres., Meacham Field, Fort Worth 7, Texas*
Chicago Helicopter Airways, *John S. Gleason, President & Treasurer, 5240 W. 63rd Street, Chicago 38, Illinois*
Continental Air Lines, *Robert F. Six, Pres., P. O. Box 9063, Denver 16, Colorado*
Cordova Airlines, *Merle K. Smith, President & Gen. Mgr., P. O. Box 6203, Anchorage, Alaska*
Delta Air Lines, *C. E. Woolman, Pres. & Gen. Mgr., Atlanta Airport, Atlanta, Georgia*
Eastern Air Lines, *E. V. Rickenbacker, Chairman of the Board & Gen. Mgr., 10 Rockefeller Plaza, New York 20, New York*
Ellis Air Lines, *R. E. Ellis, Pres., P. O. Box 1059, Ketchikan, Alaska*
The Flying Tiger Line, *Robert W. Prescott, Pres., Lockheed Air Terminal, Burbank, California*
Frontier Airlines, *L. B. Maytag, Pres., Stapleton Airfield, Denver 7, Colorado*
***Hawaiian Airlines,** *A. D. Lewis, Pres., Honolulu International Airport, Honolulu 17, T. H.*
Lake Central Airlines, *Gwin Hicks, Pres., Weir Cook Municipal Airport, Indianapolis 44, Indiana*
Los Angeles Airways, *C. M. Belinn, Pres., Box 45155, Airport Sta., Los Angeles 45, California*
Mackey Airlines, *Joseph C. Mackey, Pres., Broward County Int'l Airport, Ft. Lauderdale, Florida*
Mohawk Airlines, *Robert E. Peach, Pres., Oneida County Airport, Utica, New York*
National Airlines, *G. T. Baker, Pres., P. O. Box NAL, Int'l Airport Branch, Miami 48, Florida*
New York Airways, *Robert L. Cummings, Jr., Pres., P. O. Box 426, LaGuardia Airport Station, Flushing 71, New York*
North Central Airlines, *Hal N. Carr, Pres., 6201 34th Ave., South, Minneapolis 50, Minnesota*
Northeast Airlines, *James W. Austin, Pres., 1700 K Street, N.W., Washington 6, D. C.*
Northern Consolidated Airlines, *Raymond I. Petersen, Pres. & Gen. Mgr., 414 Fourth Avenue, Anchorage, Alaska*
Northwest Airlines, *D. W. Nyrop, Pres., 1885 University Avenue, St. Paul 1, Minnesota*
Ozark Air Lines, *Laddie H. D. Hamilton, Pres., Box 6007, Lambert Field, St. Louis 21, Missouri*
Pacific Air Lines, *John H. Connelly, Pres., San Francisco International Airport, San Francisco, California*
Pacific Northern Airlines, *A. G. Woodley, President, 1626 Exchange Building, Seattle 4, Washington*
Pan American-Grace Airways, *Andrew B. Shea, Pres., 135 E. 42nd Street, New York 17, New York*
Pan American World Airways, *J. T. Trippe, Pres., 135 E. 42nd Street, New York 17, New York*
Piedmont Airlines, *T. H. Davis, President, Smith Reynolds Airport, Winston-Salem 1, N. C.*
Reeve Aleutian Airways, *Robert C. Reeve, Pres. & Supt. Operations, Box 559, Anchorage, Alaska*
Resort Airlines, *T. B. Wilson, Chair. of the Bd. & Chief Exec. Off., Suite 326, 1346 Connecticut Ave., N.W., Washington 6, D. C.*
Riddle Airlines, *George L. Giles, President, P. O. Box 535, Miami International Airport Branch, Miami 48, Florida*
Seaboard & Western Airlines, *Raymond A. Norden, Pres., 80 Broad Street, New York 4, New York*
Southern Airways, *Frank W. Hulse, Pres., 1140 Brown-Marx Building, Birmingham, Alabama*
***Trans-Canada Air Lines,** *W. Gordon Wood, Vice Pres.-Sales, Terminal Center Bldg., 1060 University St., Montreal 3, P. Q., Can.*
Trans Caribbean Airways, *O. Roy Chalk, Pres., 160 Central Park South, New York 19, New York*
Trans Texas Airways, *R. E. McKaughan, Pres., Suite 814, First City National Bank, Houston 2, Texas*
Trans World Airlines, *Warren Lee Pierson, Chairman of the Board, 1000 16th Street, N.W., Washington 6, D. C.*
United Air Lines, *W. A. Patterson, Pres., 5959 S. Cicero Avenue, Chicago 38, Illinois*
West Coast Airlines, *Nick Bez, Pres., Boeing Field, Seattle 8, Washington*
Western Air Lines, *T. C. Drinkwater, Pres., P. O. Box 90,005, Airport Station, Los Angeles 45, California*
Wien Alaska Airlines, *Sigurd Wien, President & General Manager, Box 649, Fairbanks, Alaska*

***Associate Member**

Printed in U.S.A.

AIR TRANSPORT ASSOCIATION OF AMERICA
1000 CONNECTICUT AVE., N.W., WASHINGTON 6, D. C.

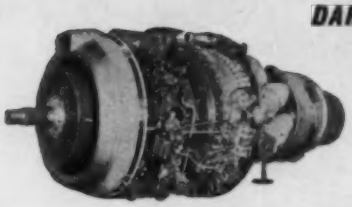
ROLLS-ROYCE

GAS TURBINES

are in service with or on order for

OVER 60 AIRLINES

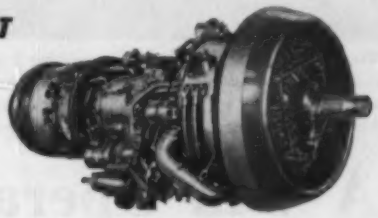
DART PROP-JET



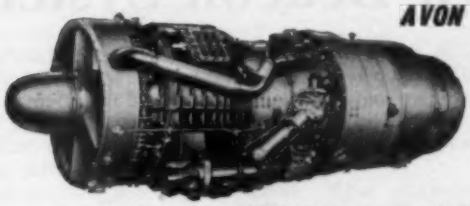
In service or under development at powers ranging from 1,540 e.h.p. to 3,200 h.p. The Dart is the most proven prop-jet in the world and has flown over 7,000,000 hours in scheduled airline service. It has an unexcelled record of reliability and is currently operating at overhaul lives of up to 2,300 hours.

TYNE PROP-JET

The Tyne is an advanced twin spool high compression engine due to enter service in 1960 at ratings of 4,985, 5,525 and 5,730 e.h.p. It has been designed to give low specific fuel consumption and is backed by the unique experience gained by Rolls-Royce in the operation of gas turbine engines in scheduled airline service.



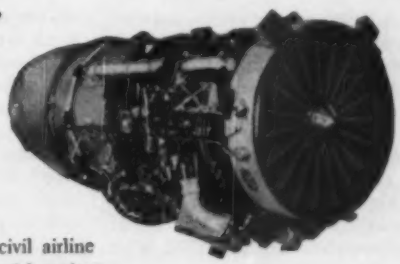
AVON TURBO JET



The Civil Avon has been developed to give low fuel consumption and long life between overhauls. The British Air Registration Board authorised its entry into service at an overhaul life of 1,000 hours.

CONWAY BY-PASS TURBO JET

The Civil Conway has the advantages of low first cost and operating costs, low weight, less noise and low specific fuel consumption. Initial Civil Conways have a guaranteed minimum thrust of 16,500 lb. and engines of 17,500 lb. guaranteed minimum thrust, will be available.



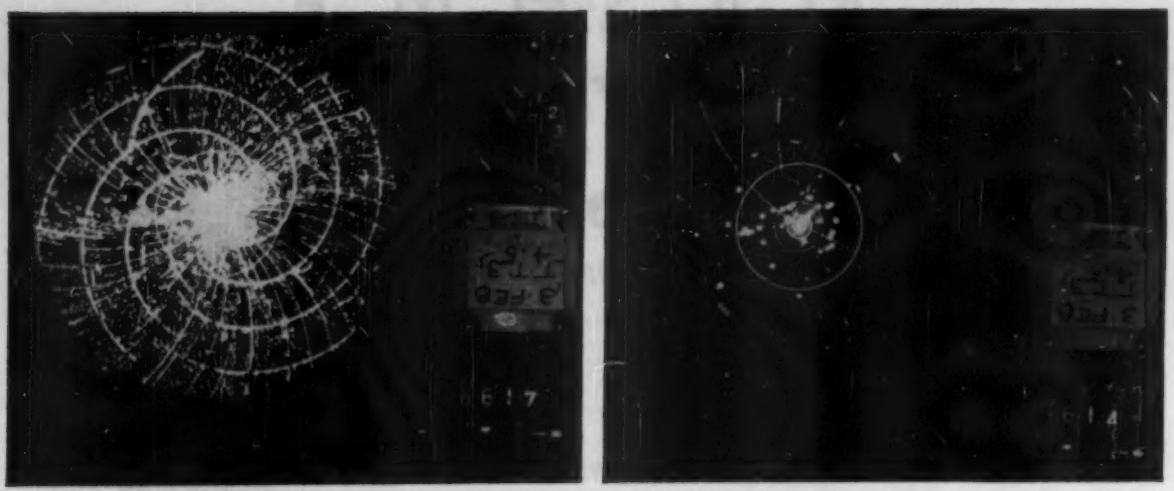
RB. 141 BY-PASS TURBO JET

The RB. 141 has been designed from the outset specifically for civil airline applications with the object of producing the best possible commercial engine for future jet transport aircraft. Engines with take-off thrusts of 13,600 lb and 14,300 lb will be available early in 1962.

Aer Lingus · Aerolineas Argentinas · Aerovias Ecuadorianas C.A. · Air Algerie · Air France · Air India International · Airwork · Alitalia Aloha Airlines · Ansett A.N.A. · Austrian Airlines · Avensa · Aviaco (Spain) · Bonanza Air Lines Inc · Braathen's S.A.F.E. · British European Airways · British Overseas Airways Corporation · British West Indian Airways · Butler Air Transport · Capital Airlines Central African Airways · Compania Cubana de Aviacion · Continental Air Lines · Eagle Aviation · East African Airways Corporation Finnair · Hong Kong Airlines · Hunting-Clan Air Transport · Icelandair · Indian Airlines Corporation · Iraqi Airways · K.L.M. Royal Dutch Airlines · La Nica · Linea Aeropostal Venezolana · Lufthansa · Middle East Airlines · Misrair · New York Airways · New Zealand National Airways Corporation · Northeast Airlines · Northern Consolidated Air Lines Inc · Ozark Air Lines Inc · Pacific Air Lines Inc Pakistan International Air Lines · Persair (Iranian Government) · Philippine Air Lines · Piedmont Aviation Inc · P.L.U.N.A. (Uruguay) Quebecair Inc · Riddle Airlines · Royal Air Maroc · Scandinavian Airlines System · South African Airways · Sudan Airways · Swissair Taca (San Salvador) · Transair · Trans-Australia Airlines · Trans-Canada Air Lines · Trans Mar de Cortes S.A. (Mexico) · Turk Hava Yollari · Union of Burma Airways · VARIG · VASP (Brazil) · West Coast Airlines Inc · Wien Alaska Airlines Inc.

ROLLS-ROYCE LIMITED, DERBY, ENGLAND

AERO ENGINES • MOTOR CARS • DIESEL AND GASOLINE ENGINES • ROCKET MOTORS • NUCLEAR PROPULSION



CLUTTERED display at left shows "fruit" resulting from reception of unsynchronized responses of airborne beacons to interrogations by other ATC radar beacon ground stations. Spiraling lines are caused by interference from nearby radars. Effectiveness of defruiting equipment is shown at right in scope photograph taken a few seconds later. There are 38 aircraft on the scope. Defruiting equipment uses dynamic storage properties of a quartz delay line to compare replies to successive interrogations in coincidence mixer.

FAA Will Operate Civil Beacon System

By James A. Fusca

New York—Nine ground installations of the Air Traffic Control radar beacon system will be transferred from experimental to operational status by the Federal Aviation Agency this summer. The decision is based on the preliminary results of a recently-concluded five month evaluation conducted jointly by FAA and the Air Force's Rome Air Development Center.

These early findings indicate that much safer and more effective control of both civil and military aircraft in areas of high traffic density and under adverse weather conditions will result from implementation of the ATC radar beacon system. The four ground stations in the New York area are to be commissioned in July; the remaining five, in Chicago, Washington, and Norfolk, by September. Civil aircraft presently equipped with the ATC radar beacon include all turbojet transports plus approximately 150 piston-engined aircraft.

Meets Requirements

An important conclusion of the study is that the civil radar beacon system meets the requirement of being operationally compatible for present and anticipated traffic densities with the military Identification Friend or Foe (IFF) beacon equipments of which there are more than 50,000 airborne units and more than 1,000 ground based units presently in use.

This compatibility means that both civil and military aircraft can operate with both civil and military air control and surveillance radars without it being necessary to carry two beacons in each aircraft.

The purpose of a secondary radar system such as the ATC beacon system is to overcome the limitations of primary radar systems now being used for air traffic control. Because primary radars depend upon the detection of the extremely small amount of radio energy reflected back to the radar from the target aircraft to establish its position, these systems are limited in that they cannot provide rapid target identification, they lose targets in the clutter on the operator's scope caused by poor weather or ground reflections, and they temporarily lose targets through inherent limitations of circuits designed to discriminate between moving and stationary objects.

DEFRUITED response of an airborne beacon replying in three pulse code is shown above. If decoders were employed, only desired codes would be displayed as single targets.

Both the civil ATC beacon system and the military IFF beacon system function in approximately the same manner to avoid these limitations. Each system employs an airborne beacon or transponder that upon receiving a coded interrogation signal from the ground transmits a train of pulses which establishes the position of the transmitting aircraft and which can be coded to furnish aircraft identification and other information.

Present Use

The basic Mark X IFF equipment has been in use with the Air Force for about 10 years. The more than 100 Aircraft Control and Warning stations of the Air Defense Command within the United States are equipped with Mark X interrogators for identifying and controlling aircraft within their sectors. Because the civil ATC beacon is compatible with the Mark X system, these AC&W stations are able to interrogate and track beacon equipped civil aircraft at present.

This compatibility is the basis for the present Civil Air Carrier Jet Advisory Service, set up by the FAA in cooperation with the military to assist in providing the additional protection required

by civil turbojet aircraft flying at high speeds at the same altitudes and along the same routes as military turbojet aircraft.

First recommendations were that civil turbojets should fly only under full positive control, but the facilities and personnel for adding this service to the present air route traffic control service simply are not available. A compromise solution has been reached whereby civil turbojets flying above 24,000 ft. make use of the Civil Air Carrier Jet Radar Advisory Service provided by assignment of FAA controllers to about 30 AC&W sites along the jet route structure within the United States.

Because all civil turbojets carry the ATC beacon which responds to interrogations from the Mark X IFF system, the civil and military controllers are able to provide cooperatively advisory information to pilots to preserve adequate separation between both types of turbojet aircraft. Any military aircraft not equipped with the Mark X IFF working in the compatible mode must receive special permission to enter or cross these routes.

In addition to being required to carry the ATC radar beacon, the civil turbojet transports are required to fly under instrument flight rules from takeoff until they are under the control of the local approach controller at their destination.

System Compatibility

There has been general agreement on the need for radar beacons as an aid to air traffic control ever since World War II, but the several civil programs under way at the start of the Korean War were terminated. In 1953 the Joint Communications-Electronics Committee of the Joint Chiefs of Staff proposed that the characteristics of the civil air traffic control beacon system be made compatible with the Mark X IFF system in line with the "common system" concept.

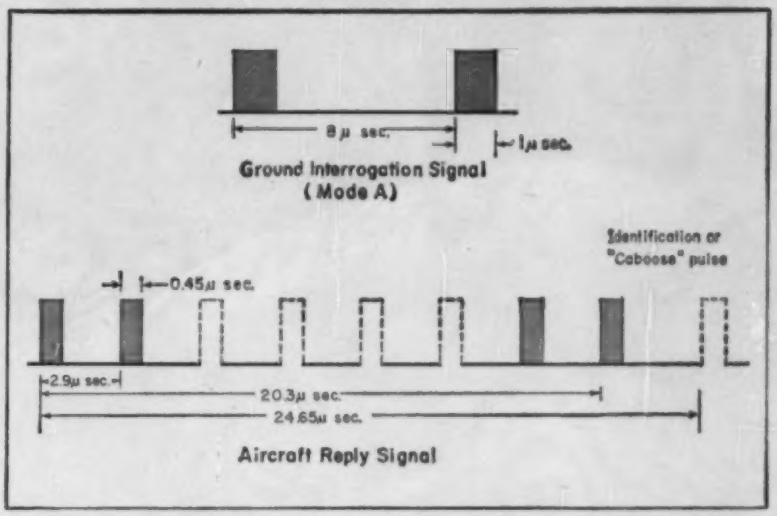
As could be predicted, there have been advantages and disadvantages to this approach. Because all interrogations are transmitted on 1,030 mc. and all replies on 1,090 mc., the airborne transponder must reply to interrogations from all ground stations in its area—and there are more than 100 civil and military interrogators in the New York area—its transmitter must be protected by automatic overload control circuits from excessive power dissipation by limiting the interrogation duty cycle.

Also, the interrogator receiver hears not only the replies to its interrogations but the unsynchronized replies to the interrogations by all other ground stations in the area.

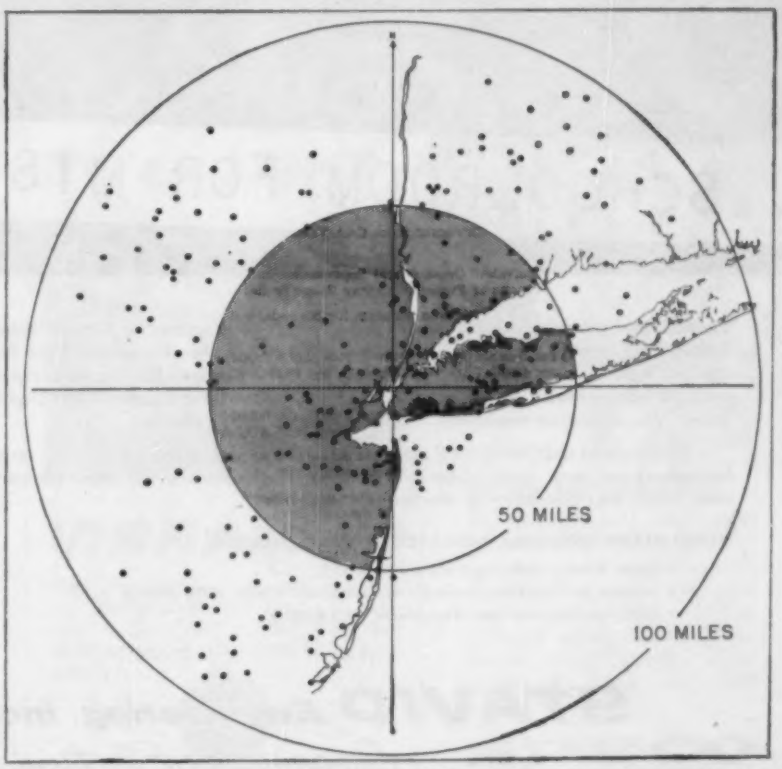
These unsynchronized replies create a type of interference clutter on the operator's scope known as "fruit" which, if not filtered out can make it extremely difficult to see the desired replies.

Certain other problems are created by the relatively low frequency of operation. For example, relatively large antennas are needed at the ground installations to obtain a high degree of directivity, these antennas must be sited on comparatively rough terrain or nulls appear in the vertical plane of the antenna beam, and the possibility exists of interference from other L-band navigational aids such as Tacan.

A related problem is that aircraft close enough to any ground station to receive interrogations from the side lobes of the ground antenna will reply and produce a "phantom" target on the oper-



TIMING of ground station interrogation signals and airborne beacon replies is shown above. Transponder is transmitting code 14. Identification pulse is transmitted only on request.



MAP of the New York area above shows estimated beacon-equipped air traffic within 100 mi. of New York for the year 1960, from a study for the FAA by Airborne Instrument Laboratory. Total of 234 aircraft are displayed.

....SCHOOLROOM FOR MISSILE MEN....

Tactical and maintenance training techniques are now enhanced by combining dynamic problems and tactical situations using a complex Simulator Test Set developed and in production at Stavid. Operational submarine-based missile crews are now being trained in system check-out procedures and guidance techniques under true operating conditions... but without firing a missile!

In the event that these men may one day have to play for keeps, they must be trained and kept ready. Stavid is helping to do this – in the most efficient, economical way possible – by electronic simulators!

Submarine simulator and mobile training devices expert GORDON E. EWERTZ, with 31-years' electronics experience, is Stavid consultant to U. S. Submarine Base, Tactical Department, New London, Conn.

OTHER STAVID UNDERSEA ORDNANCE PROJECTS INCLUDE:

- Radar Course-Directing Central AN/BPQ-2
- Average Bearing Rate Computer and Automatic Plotter MK18 MOD 0
- Data Recorder and Data Reproducer MK2 MOD 0

STAVID Engineering, Inc. Plainfield, New Jersey

Imaginative Electronics...

Outstanding engineers and scientists are invited to inquire into opportunities on Stavid's advanced systems engineering teams.

ator's display. Several systems have been proposed and evaluated for solving the side lobe suppression problem but all require modification of the ground and airborne equipment and none is considered entirely satisfactory.

The five month evaluation program that ended last February was conducted jointly by the FAA and USAF's Rome Air Development Center for the purpose of determining the seriousness of present and anticipated problems where both secondary radar systems are operating together in an area of very high traffic density.

During the period of the tests, between 60 and 80 jet interceptors assigned to the Eastern Air Defense Force flew a series of test missions in the New York area in participation with 13 FAA experimental beacon-equipped aircraft. More than 100 of the ground-based interrogators in the area triggered the beacons of the civil and military aircraft to produce as much "fruit" on the controllers' displays as possible. The military aircraft participating included F-86Ls, F-89s, and F-102As.

One of the early conclusions of the tests was that the amount of "fruit" produced did not entirely disrupt control of traffic in the area. Whatever confusion resulted from the "fruit," however, could be eliminated by means of special "defruiting" equipment developed by the Naval Electronics Laboratory and Airborne Instrument Laboratory.

Interrogation Modes

The interrogation signals transmitted by the ground stations in both the civil ATC beacon system and the military Mark X IFF system consist of pairs of pulses, each pulse being one microsecond in length. Both systems have provisions for varying the mode of interrogation by varying the spacing between the pulses.

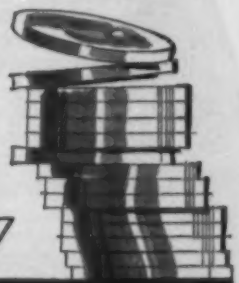
In the Mark X system, the purpose of having three modes of interrogation is for identification of the replying aircraft. In Mode 1, the Mark X interrogation signal pulses are three microseconds apart; in Mode 2 they are five microseconds apart and in Mode 3 they are eight microseconds apart.

Both ground and airborne equipments of the Mark X system can transmit one or more modes simultaneously or in sequence.

At present, only one mode of interrogation is planned for use with the civil ATC beacon—called Mode A. This mode has a pulse spacing of eight microseconds which makes it compatible with Mode 3 of the Mark X system. There are three other modes, however, that have been proposed for eventual use. These are: Mode B with a pulse spacing of 17 microseconds, Mode C with a

DELTA
Air Freight
costs less
than you think!

Holds down inventories! Holds down costs of crating, insurance, capital tie-up. Protects against deterioration and market declines!

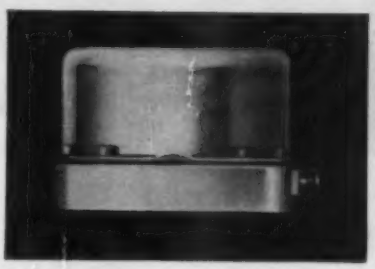


Delta AIR LINES
AIR FREIGHT
DOOR-TO-DOOR

Call Delta Air Lines, or write General Offices: Atlanta Airport, Atlanta, Ga.

MOST COMPLETE ALL-CARGO SERVICE TO AND THRU THE SOUTH

vibration pickup
1" x 1.42" SMALL
2¾ oz. LIGHT



VIBRAMITE

Highly sensitive... damped, yet with flat response to 2000 cps... omnidirectional...−85° to 500°F range. Most advanced instrument of its type today.

Send for Bulletin 112.

MB MANUFACTURING CO.
DIVISION OF TEXTRON INC.
1078 State Street, New Haven 11, Conn.

NEW
"PRE-TOOLED
FILLER CAP"
GUIDE

simplifies
design-procurement!

It's the key to a wide range of pre-tooled filler caps and components. Units adaptable to aircraft, missile, ordnance and other activity fueling systems. Many combinations direct from stock. *Why duplicate? Write for your guide today!*

SPECO
(Steel Products Engineering Co.)
DIVISION OF KELSEY-HAYES COMPANY
SPRINGFIELD, OHIO

Only PAC is certificated by the FAA to overhaul JT3 engines!

In the first commercial jet engine overhaul agreement in aviation history, Pacific Airmotive Corp. will overhaul the Pratt & Whitney Aircraft jet engines and accessories for Continental Airlines' Boeing 707 airliners.

Robert Six, Continental President, said originally his company intended to set up overhaul facilities at its new $2,500,000 base at Los Angeles International Airport—but:

"A realistic evaluation of the necessary cash outlay to equip a jet overhaul facility, and the time required to train personnel to handle the JT3, had made it evident that substantial savings in operations would result from utilizing PAC's jet engine facilities and experienced technicians."

Pacific Airmotive has processed over four hundred J57s (military equivalent of the JT3) for customers including Boeing, Douglas, Convair, North American, Northrop, Chance Vought, Pratt & Whitney Aircraft and Ford Motor Company.

PAC's veteran jet engine overhaul mechanics have accumulated more than five years experience on the J57 engine alone, with service representatives from Pratt & Whitney Aircraft stationed at PAC throughout this period to supervise personally the work performed on the engines.

Certification by FAA makes Pacific Airmotive the first (and only) Pratt & Whitney Aircraft Distributor and Authorized Overhaul Base to service JT3 engines.

Comparable experience with all important jet accessories, such as fuel controls and pumps, pressurizing and dump valves, bleed governors and valves is another vital PAC capability.

Pacific Airmotive offers outstanding craftsmanship in the servicing and overhauling of aircraft engines and accessories from a simple "O" type six cylinder to the advanced JT4 (J75). Write us for the complete brochure on the service, exchange and leasing of engines, propellers and accessories.

PAC

PACIFIC AIRMOTIVE CORPORATION

2940 North Hollywood Way, Burbank, California • Victoria 9-3481

spacing of 19 microseconds, and Mode D with a spacing of 23 microseconds.

Both ground and airborne equipment being produced now have provisions for being converted to employ more than the basic Mode A. Probably the first use of interlaced mode interrogation will be for requesting aircraft identification by Mode A and aircraft altitude by Mode B.

This interlaced operation would be by automatically alternating the pulse spacing of the interrogation signal so that the airborne beacon would first respond to Mode A and second to Mode B, with provisions for separating and decoding the replies in the ground equipment.

Looking farther into the future, thought is being given to employing Modes B, C, and D as automation modes—that is, as a form of ATC radar beacon and data link combined.

Airborne transponders in the direction of the main beam of a ground station interrogator—and, unfortunately, in the direction of side lobes as well—are interrogated by the Mode A pulses spaced eight microseconds apart. The transponders will reply up to an effective range of about 200 mi. After a delay of about three microseconds, each transponder replies with a pulse train code.

Each normal reply consists of a pair of framing or bracket pulses spaced about 20 microseconds apart. Between the framing pulses there are positions for six information pulses, each about one half microsecond in length.

The different possible combinations of the six information pulses make up a pulse train code system with a total of 64 possible codes available if all zeros and all ones are used. The reply code to be used is selected by the pilot on instructions from the ground controller.

The six binary bits transmitted by the existence or lack of a pulse in each of the information pulse positions are coded in two groups of three. Each group of three conveys in binary form the numbers one, two, and four. For this reason, although there are only a total of 64 codes, an octonary numbering system which transmits 00 through 77 is used to simplify the switching both in the air and on the ground.

In addition to transmitting the selected code, the transponder on signal from the pilot transmits for 15 sec. an identification pulse, called a "caboose pulse," about four microseconds after the normal pulse train which causes the appropriate target on the controller's display to bloom.

Civil turbojets presently are utilizing their ATC beacons to a limited degree. The Civil Air Carrier Jet Radar Advisory Service is employing only three of the 64 possible codes of the civil beacon. The reason is that many of the 30 AC&W sites cooperating have not yet received decoding equipment. Therefore, the decoding must be done visually by the controller.

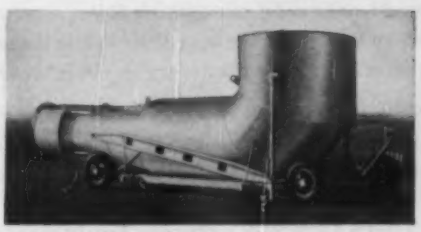
To enable the controller to distinguish between targets, the three codes in use appear as three, four, or five blips (codes 40, 42, and 62) close together in range.

Wherever possible civil aircraft are restricted to code 40 and military aircraft to code 62. Code 42 is used only when necessary to separate two civil aircraft because the four blips of the code closely resemble the four-blip emergency signal of the Mark X military system.

Codes 00 and 77 may be reserved as special purpose codes. Under consideration is the use of code 00 to identify aircraft of the Air Defense Command, and reservation of code 77 as an emergency signal to indicate an aircraft in distress.

The FAA has contracted for equipment to add a total of 55 new ATC radar beacon ground stations. The defruiting equipment is being built by Radio Receptor, and the remaining equipment by Brubaker Electronics. Airborne transponders are built by Wilcox Electric and Collins Radio. Delivery of the new ground station equipment is scheduled to begin late this year.

QUIET FOR JETS



MAXIM PORTABLE JET SILENCERS

Model JEC-10 (shown) is designed specifically for the Douglas DC-8 and Boeing 707. This rugged unit affords a high degree of silencing — without using tie downs.

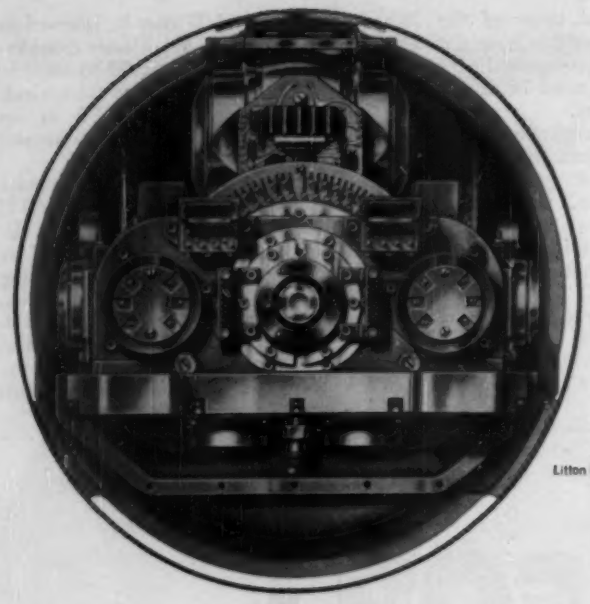
MAXIM STATIONARY TEST UNITS

Built to match your acoustical requirements. Units are engineered for future internal and external expandability — to protect you against obsolescence.

SEND FOR FOLDER, "JET ENGINE SILENCING"

Emhart Manufacturing Company
Maxim Division / Dept. 75
Box 218, Hartford 1, Connecticut

EMHART



Litton P-200 Inertial Guidance Platform 1/3 scale

Applications of an Inertial Guidance Concept

The Litton concept of two-degrees-of-freedom gyros enables two gyros to effect three-axis stabilization of a platform for an inertial guidance system.

Some of the advantages: ***Higher accuracy because of freedom from rectification drift caused by a vibration environment.***

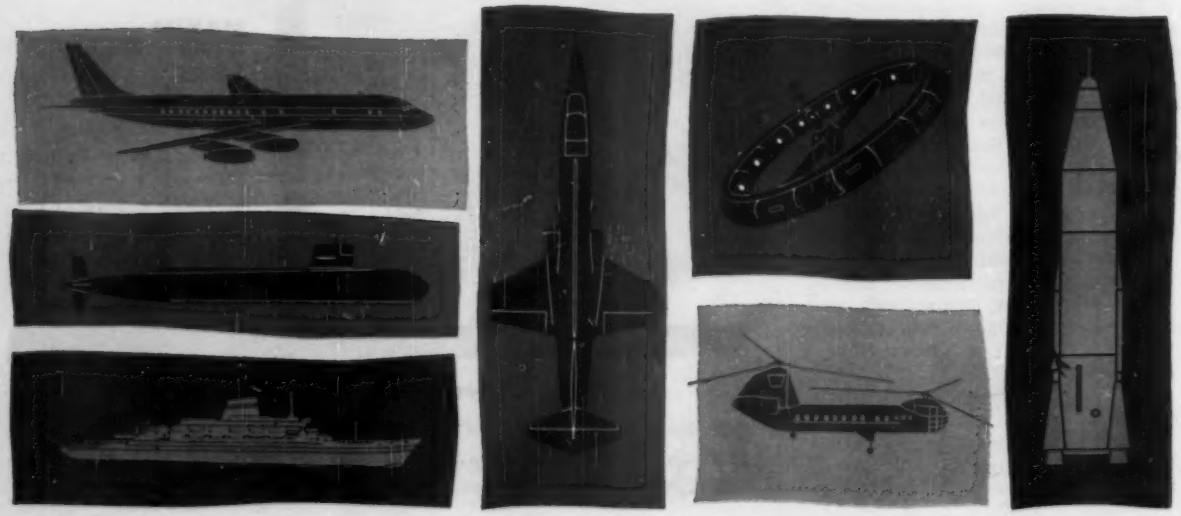
Smaller size and weight, or an order of magnitude higher angular momentum for the same weight and volume, since two large gyros fit into the same space as the three small gyros used in one-degree-of-freedom systems.

Greater reliability because of the significant reduction in complexity.

This concept and corollary concepts in the operational LN-2 Inertial Guidance System make the system fit a wide range of military and non-military applications.

Engineers and scientists who have demonstrated their ability to contribute toward further advancements in analysis, systems, development and application of inertial guidance are invited to contact Mr. C. T. Petrie, Manager, Research and Engineering Staff.

LITTON INDUSTRIES Electronic Equipments Division
Beverly Hills, California



Westinghouse Studies Infrared Systems

By Philip J. Klass

Baltimore—Airborne infrared search and track system, employing new signal enhancement techniques which are expected to double presently obtainable ranges of detecting airborne targets, is scheduled to be evaluated soon by Bureau of Aeronautics in a Navy Douglas F4D.

Developed here by Westinghouse Air Arm Division for airborne intercept (AI) fire control system use, the new infrared system might also prove useful as a self-contained airborne proximity warning device for air collision avoidance.

A number of infrared system developments are under way here to complement Air Arm Division's capability in airborne radar for use in surveillance, fire control and missile guidance. Many of these projects are based on promising new infrared component developments emerging from the company's research laboratory. These include:

- **Infrared imaging tube,** called Thermicon, which resembles a conventional television videcon tube except that it is sensitive out to longer infrared wavelengths. The Thermicon also boasts of high sensitivity, resolution, fast response and a wide field of view.
- **Ultra-sensitive infrared** detector, using gold-doped P-type germanium crystal, which Westinghouse data indicates will develop a much larger signal than conventional detectors, and over a wider portion of the infrared spectrum.
- **"Two-color" infrared detector,** which can simultaneously detect both hot and cold targets.

Airborne Intercept System

Air Arm's new infrared airborne intercept system is designed to display its target sightings on a conventional radar type C-scope cockpit presentation. This enables a single display to handle both infrared and radar data. In the automatic search mode the system sounds an alarm whenever a new target is detected.

The present prototype system has a four-degree field of view. It can be operated in either of two automatic search modes, one with a scan area of 80 deg. in azimuth by 16 deg. in elevation, the other a 30 x 16 deg. area. When the target is detected, the pilot uses a small control stick to position a cursor over the target blip on the scope, then initiates lock-on, after which the infrared head will track the target continuously. During track mode, the tracking head provides both target position and rate signals.

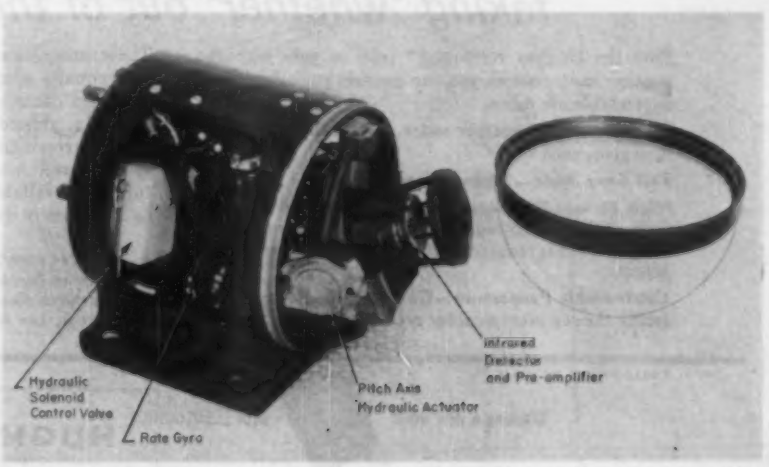
The prototype system, including six-inch tracking head, cooling provisions, amplifiers and control weigh a total of only 50 lb., excluding the scope display. In the production version, the amplifier could be constructed more compactly to lower this figure, according to Harley Lindemann. Lindemann is manager of detection systems in Air Arm's advanced development engineering group. Total power consumption for the infrared system is only 125 watts.

By way of comparison, an airborne radar with roughly equivalent performance would weigh about 250-300 lb. and consume 1,500 watts electric power, Lindemann estimates, pointing up one of the important advantages of infrared systems.

Westinghouse has packed a number of design features into a six-inch diameter scanning head which weighs only 10 lb., including two rate gyros for azimuth and elevation stabilization. These include:

- **Hydraulic actuators:** To reduce weight and bulk of the scanning head, and to provide rapid scan rates, Westinghouse designed tiny hydraulic rotary actuators to directly drive the scanner in azimuth and elevation. Each of the two actuators measures only 1¼ in. diameter by ¾ in. thick, weighs only 4 oz., and develops 41 in. lb. at hydraulic pressure of 1,000 psi. Hydraulic power is obtained from regular aircraft supply. If electric motors had been used, each

INFRARED AIRBORNE INTERCEPT system developed by Westinghouse can search out and track airborne targets at greater ranges than current systems. Major elements, from left to right, are tracking head, C-scope display and control box.



INFRARED TRACKING HEAD, gyro-stabilized, measures 6 in. in diameter, has a 4.3-in. collector and weighs only 10 lb. Miniature hydraulic actuators and control valves provide high scan and tracking rates, yet permit very compact construction.

taking "whether" out of the weather

With the Hughes TONOTRON* tube in your airborne weather radar system you can provide smoother, more dependable air miles.

Ideally suited to weather radar, the Hughes TONOTRON tube gives you:

***Full Gray Scale**—Seven different shades of gray.*

***High Picture Brightness**—In excess of 1500 foot-lamberts with full half-tone range. Even in full sunlight no viewing hood is required—thereby providing maximum safety.*

***Controllable Persistence**—Gives you flexibility in analyzing the complete weather problem.*

These same characteristics make the Hughes TONOTRON tube equally adaptable to many other military, scientific and commercial applications, such as: sector scanning, ground mapping, "B" scan radar, oscillography, armament control radar, optical projection systems and miniature radar indicators. TONOTRON tubes are available in a range of sizes...from 3 inches to 21 inches in diameter.

You can obtain additional information concerning Hughes Tonotron tubes by simply writing: Hughes Products, Electron Tube Sales, International Airport Station, Los Angeles 45, California.

*TRADE-MARK OF H. A. C.

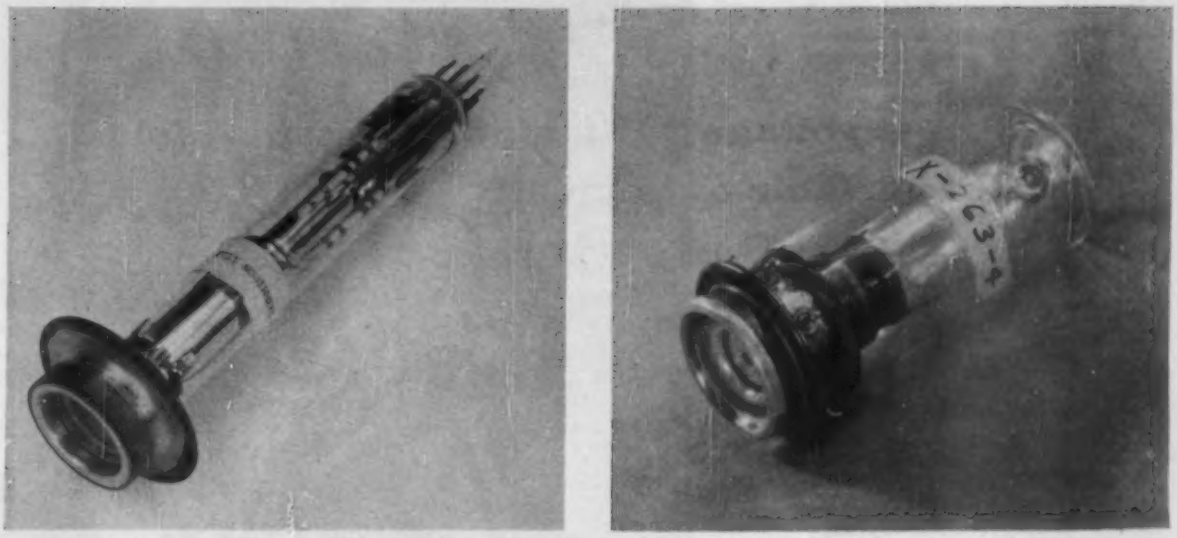
Creating a new world

with ELECTRONICS

HUGHES PRODUCTS

© 1959, HUGHES AIRCRAFT COMPANY

SEMICONDUCTOR DEVICES • STORAGE AND MICROWAVE TUBES • CRYSTAL FILTERS • OSCILLOSCOPES • RELAYS • SWITCHES • INDUSTRIAL CONTROL SYSTEMS



INFRARED COMPONENT developed by Westinghouse include Thermicon infrared imaging tube (left) which exhibits high sensitivity, fast response out through long wavelengths, and a "two-color" gold-doped germanium detector which can distinguish between two objects at only slightly different temperatures. Detector has a 0.1 microsecond response time between one and 10 micron wavelengths.

axis would have required a motor measuring 1¾ in. diameter by 3¾ in. long, weighing 1½ lb., Lindemann said.

• **Built-in test:** Scanning head contains a small infrared source and mirror system which enables the pilot to check out both the sensitivity and lock-on operation of the system before a mission.

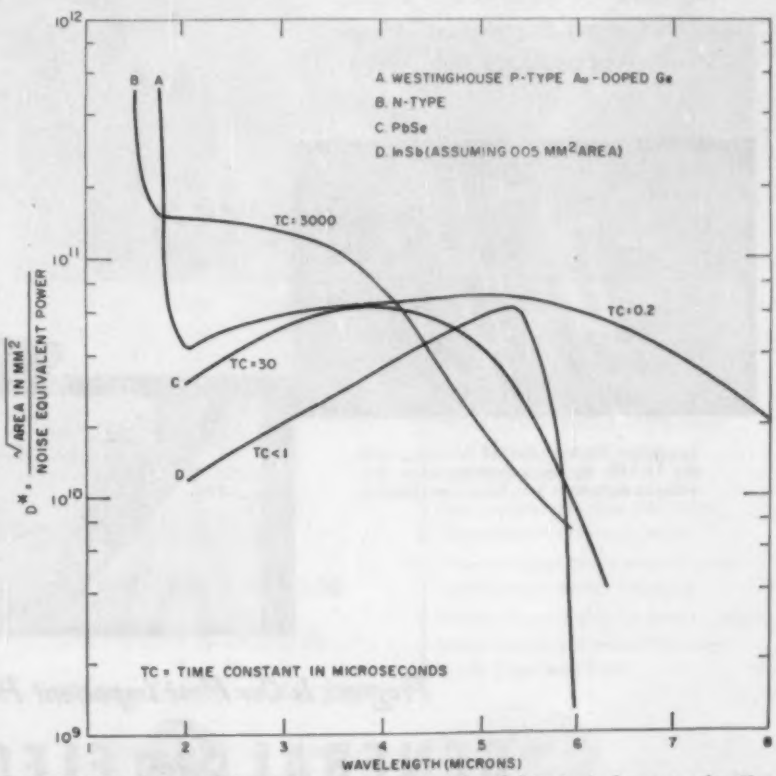
• **Preamplifier:** The all-transistor preamplifier is built around the circumference of the infrared detector to minimize signal attenuation and the introduction of spurious noise signals.

• **Cooling:** Super-regenerative cryostat is included to cool the infrared detector for improved sensitivity. Cooling gas (nitrogen) is introduced into the detector by means of a rotary joint which eliminates the need for flexible tubing.

Through use of direct hydraulic drives, Air Arm has been able to squeeze a 4.3 in. collector (corresponding to antenna size in a radar) into a six-inch diameter scanning head to achieve an effective aperture of 8½ sq. in. Folded reflective type optics with a 3.6 in. focal length are used in the prototype system. Wideband optics are used to permit change in the type of detector used, for different target applications.

For competitive and security reasons, Westinghouse is tightlipped about certain design details. Using what it terms "cancellation techniques," a company spokesman says the new infrared system "practically eliminates background radiation problems," which can cause conventional infrared systems to mistake small puffy clouds for airborne targets. Lindemann says the new Air Arm system also can track targets very close to the position of the sun without losing them.

Infrared imaging tubes developed and used during World War II operated in the very short wavelength region of the infrared spectrum, making them useful only against extremely hot targets or when the target is illuminated by an infrared spotlight. For aerial reconnaissance against comparatively cool targets, infrared system designers previously have been forced to use a mosaic of detectors, with an electromechanical commutator to scan from one element to another. The difficulty of producing mosaics with a high degree of element uniformity plus noise introduced by


A. WESTINGHOUSE P-TYPE Au-DOPED Ge
B. N-TYPE
C. PbSe
D. InSb (ASSUMING 005 MM² AREA)
TC = 3000
TC = 30
TC = 0.2
TC < 1
TC = TIME CONSTANT IN MICROSECONDS
D* = √AREA IN MM² / NOISE EQUIVALENT POWER
WAVELENGTH (MICRONS)

SENSITIVITY of new gold-doped P-type germanium infrared detector is shown as a function of wavelength alongside response of three other types of infrared detectors.

Most voltage per pound of any portable... most portable of them all!

Here's x-ray that's truly portable — you *can* take it with you. It's General Electric's new LX-140 — with a compact tubehead weighing only 46½ lbs. Travels with control unit in a jolt-resistant case that looks like a handsome piece of luggage. Tote it along to inspect pipe lines, pressure vessels, castings, aircraft, storage tanks, tank cars, ships.

Power aplenty! Highest voltage per pound — 70 to 140 kvp range. Able to radiograph 1¼-in. steel with a 90-second exposure. And easier to operate than a TV set.

Your G-E x-ray representative has the facts. Or write X-Ray Department, General Electric Co., Milwaukee 1, Wisconsin, for Pub. WA-54.

Sequence shows ease of working with the LX-140. Its beam-defining cone provides an automatic 9-in. focal-film distance.

Progress Is Our Most Important Product

GENERAL ELECTRIC

PREAMPLIFIER for airborne intercept system is built around the periphery of the infrared detector to reduce noise pickup.

TINY hydraulic actuator is used to drive the infrared tracking head.

commutation of low-level detector signals has limited system sensitivity and performance.

The new Westinghouse Thermicon opens the way to the design of greatly improved aerial reconnaissance systems because of the device's high sensitivity, resolution and fast response time, the company says. For example, video integration techniques can be used to reduce background radiation and improve target resolution. Track-while-scan techniques used in radar systems also can be employed to permit simultaneous tracking of multiple targets.

Present prototype models of the Thermicon measure one inch in diameter by nine inches long. The tube is just emerging from the research laboratory, but should be in pilot production before the end of the year, a company spokesman says. Detailed performance data is classified at present.

A recently developed gold-doped P-type germanium infrared detector, currently in production at Westinghouse Semiconductor Department, exhibits high sensitivity over a wide portion of the infrared spectrum, from approximately one to 10 microns when cooled to liquid nitrogen temperature of about 78K. This, coupled with the device's extremely fast response time, makes it greatly attractive for airborne reconnaissance systems working against relatively cool ground targets.

The new gold-doped germanium de-

Molded Harnesses for Missiles

Powered by the tremendous thrust of a rocket engine produced by the Reaction Motors Division of Thiokol Chemical Corporation, the North American X-15 —the first manned space vehicle—will exceed speeds of 3600 mph and will penetrate more than 100 miles into space. Revere Molded Harnesses, developed in conjunction with Reaction Motors' engineers, will supply the vital electrical interconnections for this mighty powerplant.

The completely sealed and protected harnesses exceed rigid specifications and provide:

1. Continuous operation from −70°F to +275°F
2. Ten minute operation at +500°F without damage
3. Protection against the occurrence of corona; operation at 100,000 feet without corona
4. Environmental protection against H_3O_2, anhydrous ammonia, liquid oxygen and 100% humidity

Harnesses for the X-15 engine are another example of the many types of specially designed Revere harnesses. Electrical interconnections for airborne and ground applications, thermocouple harnesses for heat measurement, molded harnesses for complete environmental protection—all are custom engineered to meet specific requirements.

CALL ON REVERE...
WHEN YOUR PROJECT RATES THE BEST RATHER THAN "OFF-THE-SHELF" TREATMENT

when you want engineering abilities and specialized facilities in the fields of:

- Liquid Level Indication and Control
  Flow Indication and Control
  Flow Measurement
- High Temperature Wire and Cable
  Thermocouple Wire and Cable
- Thermocouples, Harnesses and Leads
  Electrical and Molded Harnesses
- Weight, Force and Thrust Measurement
  Determination of Center of Gravity
  Strain Gage Load Cells

REVERE CORPORATION OF AMERICA

Wallingford, Connecticut

A SUBSIDIARY OF NEPTUNE METER COMPANY

52

DYNA-SOAR

Dyna-Soar (for dynamic soaring) is a joint project between the Air Force and the NASA, and is an attempt to solve the technical problems of manned flight in the sub-orbital regions. Advance knowledge on the project indicates how a boost-glide vehicle can operate from the outer fringes of the atmosphere where it can maneuver and be recovered undamaged. Studies show that by varying the original rocket boost, and thus the velocity, and with the control available to the pilot, the Dyna-Soar aircraft can circumnavigate the earth, followed by a normal and controlled landing. Boeing Airplane Company, one of the competing companies for the development contract for the complete boost-glide system, has delegated to RCA the responsibility for the development of important electronic components of Dyna-Soar.

RCA

RADIO CORPORATION of AMERICA

DEFENSE ELECTRONIC PRODUCTS

CAMDEN, N. J.

Tenbit ®

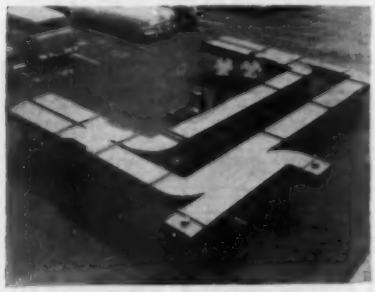
tector has a noise-equivalent-power (NEP) of 5 x 10^{-11} watts at temperature of 78K, and an NEP of 1.6 x 10^{-11} watts at 60K, with a time constant of better than 0.2 microsecond, Westinghouse says. By way of comparison, a conventional lead selenide detector operating at 78K has comparable sensitivity only from approximately two or five microns, after which it falls off sharply, and its time constant is about 30 microseconds.

Signal level output from the gold-doped germanium detector as well as the cell noise level are a direct function of the direct current bias current applied so that the signal-to-noise ratio of the cell is essentially constant at all normal bias levels. This enables the infrared system designer to select a detector bias current which makes the rms noise contributed by the preamplifier insignificant.

Under sponsorship of Wright Air Development Center, Westinghouse has developed a "two-color" gold-doped germanium infrared detector which can effectively discriminate between targets of slightly different temperatures. Operating range is one to 10 microns. With a signal-to-noise ratio of 4:1, the cell can discriminate between two targets whose temperatures differ by only 0.02K when the two are at approximately 283K (10C), Lindemann says. Security prevents disclosure of operating principles, the company says.

Air Arm has also developed a new closed-cycle cooling system for infrared detectors which is intended to eliminate the need for replenishing cooling fluid after each mission.

It consists of a diaphragm type compressor driven by a small hydraulic actuator powered from vehicle's main hydraulic supply The system achieves temperatures of approximately 98K and weighs about 10 lb.



Waveguide Complex

Giant waveguide complex, built for an undisclosed extremely long-range, high-power early warning radar (probably the Ballistic Missile Early Warning System) by Airtron, dwarfs two company engineers. Designed for operation at UHF frequencies, the resonant rings of the waveguide multiply input power by factor of more than 20:1.

the only jet-starter hose with government approval

Rugged Quaker jet-starter hose is the first and only hose of its kind to receive U.S. Government approval for use in starting jet engines.

500° air under great pressure inside—arctic temperatures outside—can't hurt this brute. The inevitable whipping under jet-starting pressures never causes air blockage from kinking. Hose length remains constant under pressurization and depressurization. And the extra spiral scuff jacket on the outside takes the roughest abrasion while maintaining the flexibility necessary for quick ground operations.

Get complete information on Quaker jet-starting hose from your local Thermoid industrial distributor, or write *Thermoid Division, H. K. Porter Company, Inc., Tacony & Comly Sts., Philadelphia 24, Pa.*

THERMOID PORTER DIVISION

H.K. PORTER COMPANY, INC.

PORTER SERVES INDUSTRY: with Rubber and Friction Products—THERMOID DIVISION; Electrical Equipment—DELTA-STAR ELECTRIC DIVISION, NATIONAL ELECTRIC DIVISION; Copper and Alloys—RIVERSIDE-ALLOY METAL DIVISION; Refractories—REFRACTORIES DIVISION; Electric Furnace Steel—CONNORS STEEL DIVISION, VULCAN-KIDD STEEL DIVISION; Fabricated Products—DISSTON DIVISION, FORGE AND FITTINGS DIVISION, LESCHEN WIRE ROPE DIVISION, MOULDINGS DIVISION; and in Canada, Refractories, "Disston" Tools, "Federal" Wires and Cables, "Nopcoduct" Systems—H. K. PORTER COMPANY (CANADA) LTD.

ADVERTISEMENT

Higher-Temperature Capacitors:

New Dielectric Materials Help Break the Heat Barrier

By Marc F. Warmuth, Staff Engineer, Airborne Accessories Corporation

Special Mylar*, Teflon† and mica constructions permit continuous operation up to 600°F

Three new types of special high-temperature motor-starting capacitors, utilizing Mylar, Teflon and mica dielectric respectively, have been developed recently by Airborne. The Mylar and Teflon types are wound of very thin metallized film for greatest possible miniaturization. The mica type is wound of a sandwich of aluminum foil and thin, pure mica ribbon, metallized mica not being procurable. All are encapsulated with thermoplastic polyamide or thermosetting epoxy resins (depending on temperature range) in sealed, cold-drawn steel cans with fused glass terminals. This construction provides low inductance units of exceptional mechanical sturdiness and environmental resistance.

As an alternate construction for less demanding applications, encapsulation in epoxy sleeves, with leads brought out through potted ends, is also available.

Mica for highest temperatures

The great advantage of mica as a dielectric is its ability to maintain its physical and electrical characteristics at temperatures up to 1000°F. All dielectric materials undergo severe reductions in insulation resistance at high temperatures, but with mica the critical value is reached around 600°F. Full voltage ratings up to this point are thus permitted. And with the right epoxy resin impregnant, mica capacitors are well able to withstand overtemperatures without damage . . . if not simultaneously subjected to full rated voltages.

Mica capacitors are three to four times larger than Mylar or Teflon units of comparable capacitance and voltage rating. This is because a greater thickness of dielectric must be used in addition to a separate layer of aluminum foil.

Mylar and Teflon for intermediate high temperatures and small size

Mylar can be worked continuously up to 300°F and Teflon up to 400°F. For applications below these limits, but above the normal 185°F limit of more conventional insulating materials, metallized Mylar and Teflon offer high dielectric strength. They make possible wound capacitors of very small size with good voltage ratings and excellent capacitance-to-volume ratios.

A further advantage of metallized Mylar and Teflon capacitors is their self-healing characteristic. The short occurring when the dielectric is ruptured instantly burns the thin metallic coating back from the edges of the rupture, making further flashover impossible. Yet the amount of metallic coating burned away is so minute that hundreds of such self-healings have little effect on capacitance. Resistance to overvoltages can thus be considered excellent. Resistance to over*temperatures*, on the other hand, is not an outstanding characteristic of Mylar or Teflon—a design factor to keep in mind.

Summary

MYLAR: For intermediate high temperatures, high voltage and smallest size. Continuous operation at 300°F with ratings up to 1000 WVDC. Capacitance variation with temperature good, but not as good as that of Teflon or mica types.

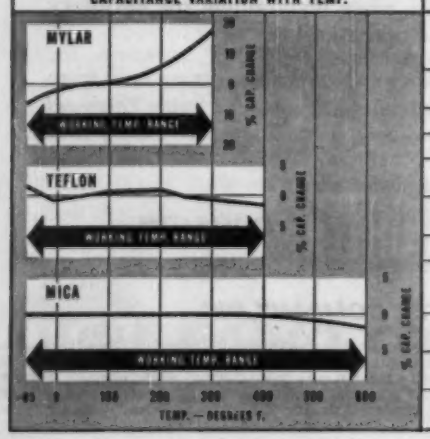
TEFLON: For intermediate high temperatures and small size. 600 WVDC up to 400°F without derating.

MICA: For highest temperatures. Continuous operation, 600 WVDC without derating up to 600°F. Higher temperatures possible with derating. Larger in size than equivalent Mylar or Teflon capacitors.

For proposals on your specific capacitor requirements, write AIRBORNE ACCESSORIES CORPORATION, HILLSIDE 5, N.J.

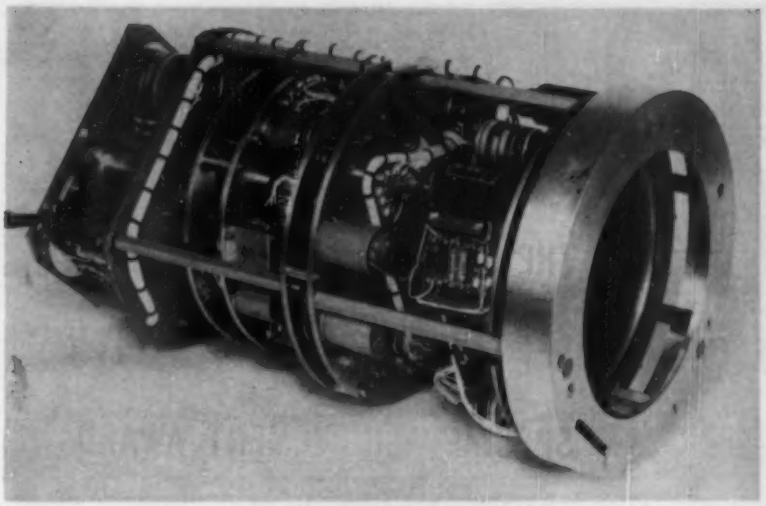
**DuPont's tm for its polyester film*
†DuPont's tm for its tetrafluoroethylene resin

CAPACITANCE VARIATION WITH TEMP.

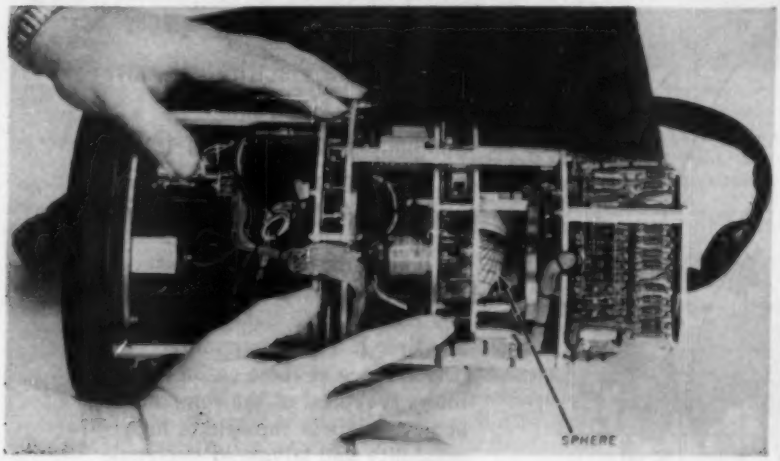


TABULATED CHARACTERISTICS—AIRBORNE SPECIAL HIGH-TEMPERATURE CAPACITORS

TYPE	MYLAR Wound, Metallized Mylar Film	TEFLON Wound, Metallized Teflon Film	MICA Wound Alum. Foil with Mica Ribbon
Working temp. range	-65 to + 300°F (-55 to + 150°C)	-65 to + 400°F (-55 to + 205°C)	-65 to + 600°F (-85 to + 315°C)
Voltage ratings	200-1000 WVDC	200-600 WVDC	200-600 WVDC
Capacitance range	.01 mfd up	.01 mfd up	.01 mfd up
Capacitance variation with temp.	Very good to 150°F Good 150-300°F	Excellent to 250°F Very good 250-400°F	Excellent to 350°F Very good 350-600°F
Insulation resistance	50,000 meg x mfd at 78°F 10 meg x mfd at 257°F	500,000 meg x mfd at 78°F 75 meg x mfd at 300°F	10,000 meg x mfd at 78°F 4 meg x mfd at 600°F
Dielectric strength	4000 v/mil	1500 v/mil	1000 v/mil
Size	D L	1.1xD 1.1xL	3w4xD 3w4xL
Capacitance change vs time at max. working temp.	-5% or less after 250 hr	-5% or less after 250 hr	-5% or less after 250 hr
Overvoltage resistance	Excellent (Self-healing)	Excellent (Self-healing)	Non-self-healing
Short-time exposure to overtemperature	Poor	Poor	Very good with derating



NAVY three-dimensional flight indicator in seven-inch-diameter case will undergo flight evaluation soon. The 10 lb. indicator is designed to give a pilot the feel of flying contact by showing rotating clouds during a turn, simulated horizon that pitches and rolls, and horizontal lines that move toward pilot at speed proportional to airplane velocity. Translucent sphere (arrow below), with many degrees of freedom, is heart of the device.



Three-Dimensional Pilot Display Will be Flight-Tested in F9F-8T

Johnsville, Pa.—First flight in Navy's evaluation of a cockpit indicator which combines attitude, heading, rate-of-turn, flight director and altitude commands and an indication of forward velocity in a single display with a three-dimensional feel, is scheduled soon in two Grumman F9F-8T aircraft being instrumented for the evaluation.

The instrument, called a "Contact Analog Flight Display," is an attempt to speed the use of some of the advanced ideas of the longer-range Army-Navy Instrument Program (ANIP) DV-10 panel which will employ cathode ray tubes for TV-type presentation of flight data (AW Aug. 11, p. 48).

The CC-4 attitude indicator was conceived here by Naval Air Development Center's Aeronautical Instruments Laboratory. The device was designed and constructed by Waldorf Instrument Co., Huntington Station, N. Y. The indicator already has undergone initial evaluation in an NADC flight simulator.

Each of the two-place F9F-8T aircraft will be fitted with a conventional cockpit panel and one of the new Navy DV-4 simplified panels, including the new three-dimensional indicator and a horizontal situation display. Both are electromechanical devices in contrast to the all-electronic displays under development for the advanced DV-10 program.

During the flight evaluation, expected to last six to nine months, Navy plans

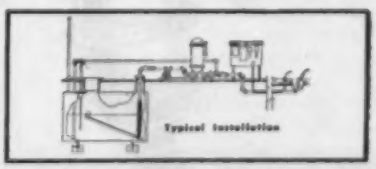
CHOOSE REDA PUMPS FOR YOUR AIRCRAFT REFUELING SYSTEMS!

VISCOUNT refuels at Tulsa Municipal Airport using Reda Jet-Fuel Submergible Pumps.

REDA **Jet-Fuel** Submergible Pumps Give These Important Advantages:

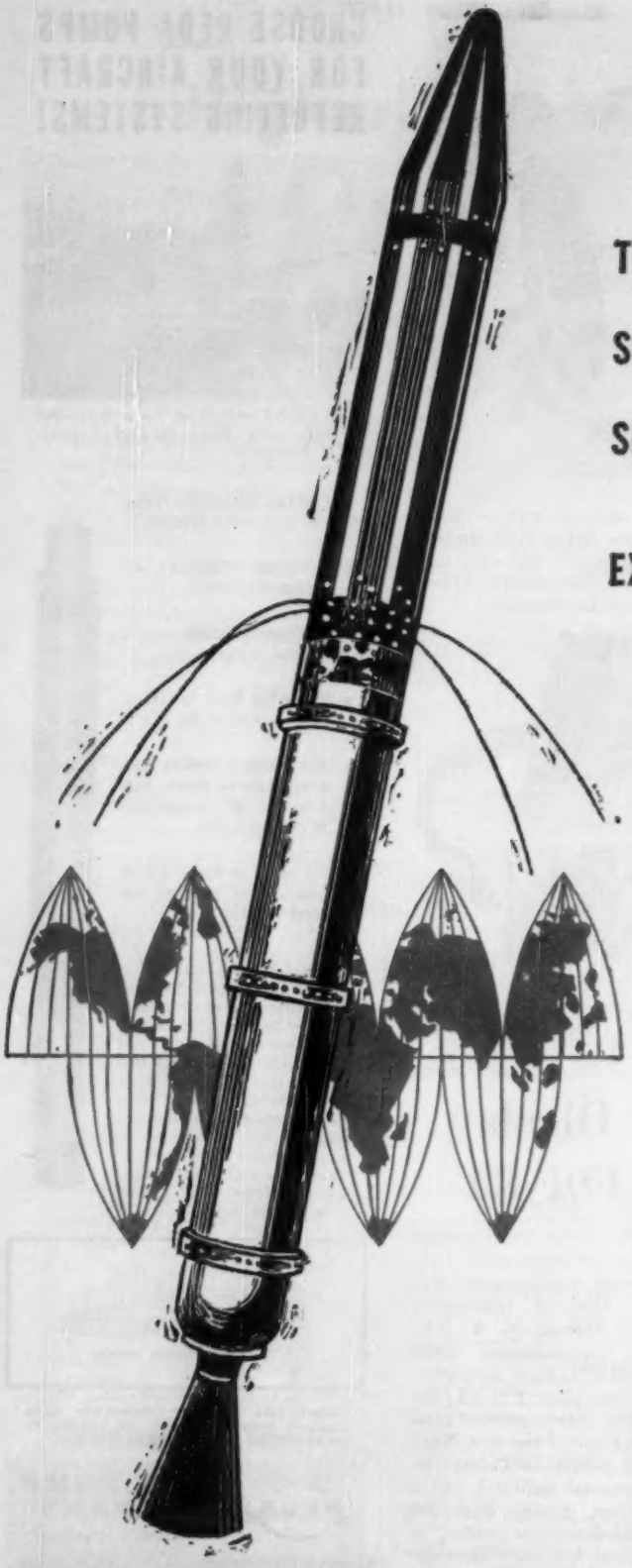
- **Underground Installation** — no surface structures.
- **No Explosion Hazards** — U/L approved models.
- **No Stuffing Boxes To Leak** — motor & pump in one unit.
- **High Volume at Required Operating Heads** — Models from 1 to 150 HP — capacities to over 1000 GPM.
- For single or double hydrant systems, tank truck and test stand refueling systems.

Illustrated is a typical Underground Storage and Hydrant Refueling System with Reda Jet-Fuel Submergible Pumps, used by Continental Air Lines. This system uses two storage tanks and two Reda pumps feeding into a filter and hydrant refueling system. *It has proved to be less expensive in both installation and maintenance than a conventional tender system would have been.*



Contact Reda Today For Submergible Pumps Especially Designed To Meet The Exacting Requirements Of Aircraft Refueling Systems.

REDA PUMP COMPANY
BARTLESVILLE, OKLAHOMA
World's Largest Manufacturer of Submergible Pumps for Oil, Brine, Water, Gasoline, Jet Fuel, Chemicals and LPG, for over 25 years.



THE U.S. ARMY
honors
SPRAGUE ELECTRIC COMPANY
with a
SPECIAL ACHIEVEMENT AWARD
in recognition of
notable contributions to
EXPLORER I . . .

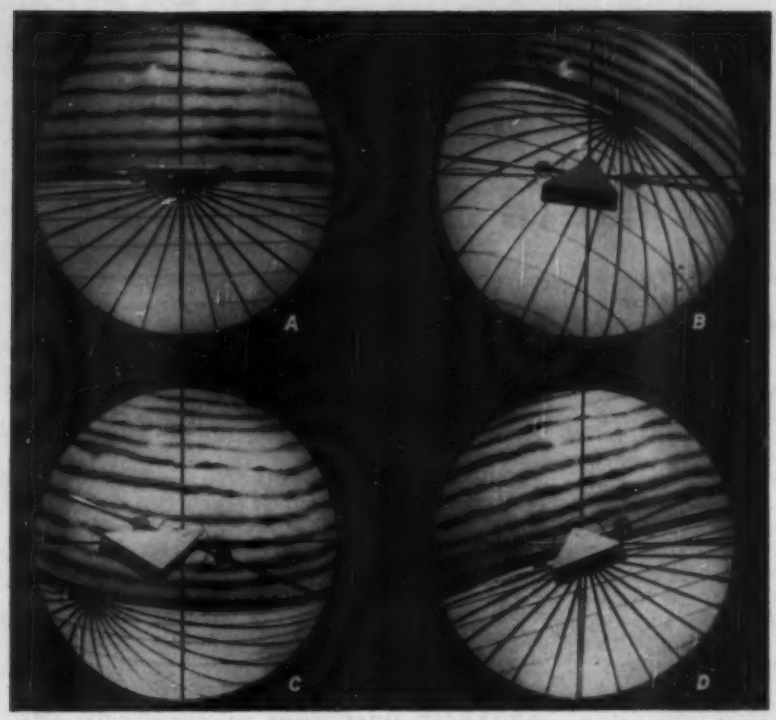
America's first response to the challenge of outer space.

The Sprague Electric Company is the only electronic component manufacturer to be so honored by the U.S. Army.

Sprague designed and manufactured the solid tantalum and miniature metal-clad paper capacitors as well as the key noise suppression filters used with Explorer I. The outstanding performance of these capacitors and filters is typical of the company's achievements in the field of high reliability and advanced electronic technology. Developed through Sprague's extensive research facilities, these components have amassed an unprecedented record of reliability. Through continued research, Sprague Electric Company plans to meet the even greater challenges of the future with newer and better products . . . higher and higher reliability.

SPRAGUE®
THE MARK OF RELIABILITY

SPRAGUE COMPONENTS:
CAPACITORS • RESISTORS • MAGNETIC COMPONENTS • TRANSISTORS • INTERFERENCE FILTERS • PULSE NETWORKS
HIGH TEMPERATURE MAGNET WIRE • CERAMIC-BASE PRINTED NETWORKS • PACKAGED COMPONENT ASSEMBLIES



INDICATOR presentation for different flight situations is shown. In (A), the airplane is in straight and level flight and on desired flight path. In (B), the airplane is nose down in a slight left bank and in a slow rate of turn, slightly high and to the right of the desired flight path. In (C), the aircraft is climbing, has a rapid rate of turn to the right, and is considerably above and to the right of the flight path. In (D), the airplane is banked to the right and is above the desired flight path.

to use 20 to 25 different pilots—some experienced, some students. Aircraft are being heavily instrumented to record 24 different functions, including stick motions, which will permit direct comparison of the relative effectiveness of conventional and the new instrumentation, according to Louis Guarino, chief of the Design and Stabilization Division of NADC's Aeronautical Instruments Laboratory.

The Waldorf contact analog flight display is housed in a seven-inch diameter case, 11 in. long, weighing 10 lb., including the all-transistor servo amplifiers required for the instrument's servo systems.

Heart of the indicator is a translucent sphere whose upper half is painted to resemble cloud formations. Inside this sphere is another translucent sphere whose lower half has black lines which converge to the sphere's horizon, giving the appearance of a number of parallel railroad tracks.

Operating from signals obtained from a separate vertical gyro, the two spheres are driven clockwise or counterclockwise by tiny servo motors with respect to a set of large crosshairs whenever the airplane rolls. The two spheres rotate up or down whenever the airplane changes pitch attitude.

When the airplane changes heading, the upper half of the outer sphere (with clouds)rotates in an appropriate direction and continues to rotate so long as the airplane is in the turn.

The lower half of the inner sphere (with converging lines) rotates only through a limited angle, proportional to the airplane's rate of turn. Thus it moves only at the initiation and termination of a turn, taking up a position proportional to the rate of turn after the airplane has entered the turn.

The signal for the servo motor driving the upper half of the outer sphere is obtained from a separate directional gyro. The first derivative of this signal provides the rate-of-turn signal for operating the motor that rotates the inner sphere.

The lower half of the outer sphere, which can be rotated independently of the top (clouds) half, gives the pilot an indication of his airplane's forward speed.

Horizontal-spiral lines inscribed on the lower half of the outer sphere give the impression of horizontal lines moving toward the pilot, like flying over railroad ties, when the lower half is rotated.

A signal proportional to the airplane's indicated air speed or ground speed is

A Personal Invitation to
ENGINEERS

from ROBERT McCULLOCH
President

"If you would like to be a member of a select corps of Engineers, working for an interesting, growing company . . in one of the country's most stimulating areas . . I invite you to write to Temco. Temco's growth is sound and planned, its products are diversified and challenging, our facilities are modern. Every benefit, for you professionally and in good living for you and your family, is here. Below are some of the areas in which jobs are open now."

ANTENNA DEVELOPMENT

Graduate Electronics Engineer or Physicist to perform analysis and design of antenna, microwave, and propagation systems for use in missile guidance and reconnaissance. Individual will be responsible for performing investigations in new types and concepts of transmitting and receiving antennas for both pulsed and CW signals, and the adaptations of these studies to current use in Electronic Development projects.

SENIOR FIELD SERVICE ENGINEER

Openings exist for a graduate Electronics Engineer with five years' experience in radar systems development, to be responsible for technical assistance and maintenance of Temco hardware in the field. Recent industry or military electronics experience with any of the following types of radar equipment is necessary. APS-20E, APS-45, FPS-20, FPS-8, FPS-6, MPS-11. The Field Engineer will coordinate the operation and application of the equipment to field uses with the Engineering Development sections.

Write BILL G. HICKEY
Supervisor Technical Employment
Room 305A, P. O. Box 6191

TEMCO
AIRCRAFT CORPORATION • DALLAS 22, TEXAS

Progress in Space Technology

How General Electric delivered first U.S. operational re-entry vehicle

General Electric Missile and Space Vehicle Department helped USAF Ballistic Missile Division solve re-entry problem . . . speed Thor operational readiness.

CAPABILITIES DEVELOPED RAPIDLY—Early in 1955, General Electric's Missile and Space Vehicle Department began research and development work on the vitally important re-entry phase of the USAF ballistic missile program. A skilled core of G-E scientists with hypersonic and missile technology experience were pulled together from all parts of the Company. Special research tools were developed and put into use at MSVD's new Aerosciences Laboratory. Advanced shock tunnels reproduced high Mach air flows—10,000 to 25,000° F plasma jets simulated extreme re-entry heats. With such new tools, G.E. gained vital knowledge of the re-entry environment.

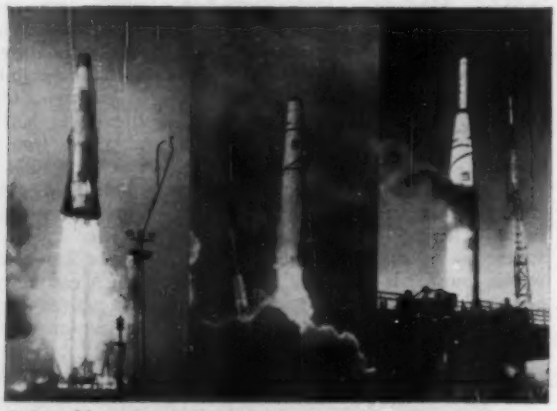
FLIGHT TEST PROVED DESIGN—MSVD engineers were convinced that the heat-sink type re-entry vehicle offered the best approach to providing the Air Force with an *operational* weapon at the *earliest possible date*. Later, flight tests proved the soundness of the General Electric approach. On schedule, only 30 months after research and development began, the Air Force launched the free world's first operational re-entry vehicle on Thor.

Missile and Space Vehicle Department engineers were also able to make important advances on other fronts associated with the re-entry challenge. Complex re-entry vehicle ground support equipment was developed; rocket-sled tests aided in solving fuzing problems. It was also necessary to build one of the country's most advanced data processing and computation centers to keep pace with the need for rapid processing of Air Force re-entry data.

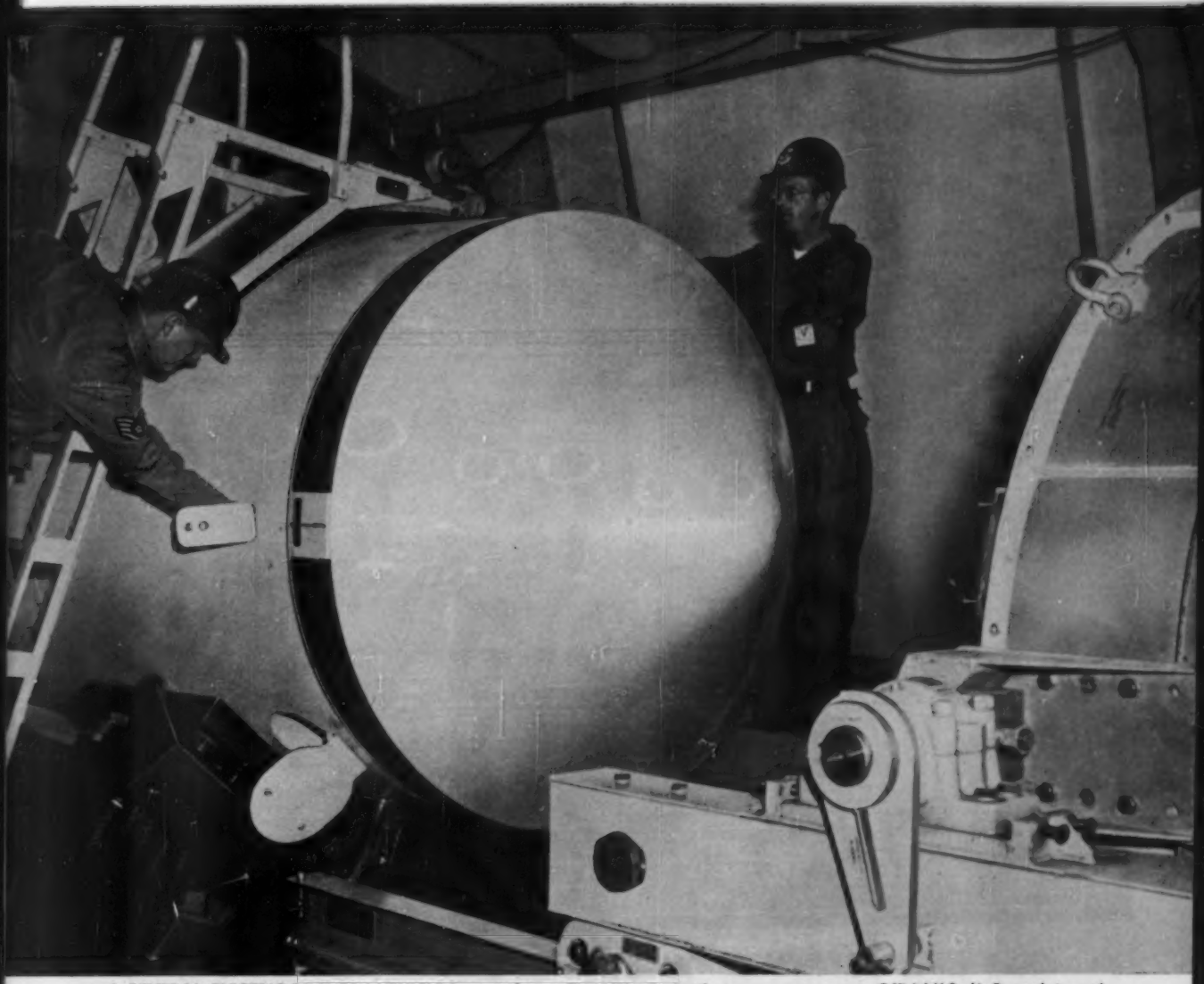
PRODUCTION ON SCHEDULE—To prepare for Thor missile re-entry vehicle production, General Electric acquired and developed special manufacturing facilities and techniques. Proof of the smooth, rapid transition from research and development to production is the fact that Thor re-entry vehicles have passed *all operational qualification tests* and are being delivered on schedule to the Air Force for air lift to key overseas bases.

ADVANCED NOSE CONE DEVELOPMENT—Meanwhile, development continues on more advanced re-entry vehicles. Last year, one such G-E re-entry vehicle, the Thor-Able, successfully re-entered at an ICBM range of over 5500 nautical miles. With more than four years of success as an associate contractor on the Atlas, Thor and other programs, *General Electric is the leader in re-entry vehicle development and production experience.* This proven competence will continue to grow as MSVD applies its re-entry experience to the expanding list of new missile and space projects. *Missile and Space Vehicle Department of the Defense Electronics Division.* 124-50

NATION'S LARGEST PLASMA JET PLAYS KEY ROLE in providing information leading to the solution of the re-entry problem. Plasma Air Arc and many other re-entry research tools were developed by MSVD Aerosciences Laboratory scientists.



OVER 1½ YEARS OF FLIGHT TEST EXPERIENCE on Atlas, Thor and Thor-Able missiles has been gained by General Electric covering both heat-sink and ablating types of re-entry vehicles for the USAF. These three ballistic missiles are pictured above.



A GENERAL ELECTRIC RE-ENTRY VEHICLE is mated to a Thor Missile in the first SAC operational test flight exercise from Vandenberg Air Force Base.

Official U.S. Air Force photograph

RE-ENTRY VEHICLES ARE ASSEMBLED at MSVD facilities in Burlington, Vt., for both THOR and ATLAS ballistic missiles.

These Free Booklets Describe MSVD Ballistic Missile Re-entry Vehicle Work.

Indicate the brochures that you would like to have and send to: Section E224-50, General Electric Co., Schenectady, New York.

Capabilities of G.E.'s Missile and Space Vehicle Department	**GEA-6904A**
Space Technology Progress	**GEA-6876**
Heat Sink Nose Cone	**PIB-2**
Design and Fabrication of Re-entry Vehicles	**GER-1583**
Heat Protection of Re-entry Vehicles	**GER-1582**

Progress Is Our Most Important Product

GENERAL ELECTRIC

YOU ASKED FOR IT . . .

FOR MISSILE AND AIRCRAFT SYSTEMS . . .

VARIABLE DISPLACEMENT PUMP DATA

MODEL	DISPL. IN 3/REV.	RATED RPM	RATED GPM	MAX. RPM	ENVELOPE DIM. DIA.	ENVELOPE DIM. LENGTH
P175	1.750	4000	29.4	5000	5.750	8.320
P105	1.050	4000	17.3	6000	5.250	7.250
P56	.568	6000	13.9	8000	4.687	6.625
P16	.163	12000	7.9	16000	3.000	4.250
P11	.115	12000	5.5	16000	2.750	3.625
P064	.064	12000	3.1	18000	2.125	3.125
P044	.044	12000	2.1	18000	2.125	3.062

A NEW FAMILY OF BENDIX CONSTANT AND VARIABLE DISPLACEMENT HYDRAULIC PUMPS

SMALLER • LIGHTER • FEWER PARTS • SYMMETRICAL ENVELOPE • COMPACT • RUGGED DESIGN

INHERENT HIGH SPEED CAPABILITIES • SUPERIOR CONTAMINATION TOLERANCE • HIGH RELIABILITY

The rugged, simplified construction of Bendix® hydraulic pumps plus precision production and quality control experience provide pumps with increased reliability for missile and aircraft systems. Smaller envelopes permit interchangeability with existing installations and compact packaging for new applications. Thousands of hours of endurance, qualification and flight testing have proven the Bendix family of hydraulic pumps will exceed all existing customer and military requirements.

Pumps are furnished as separate components or as an integral part of complete sub-systems. Standard pumps are furnished with forged aluminum housings for temperatures up to 400°F. and pressures up to 4,000 psi. Previous qualification of pumps for 550°F. assures you of high reliability for lower temperatures and availability of proven pumps for high temperature systems.

Advanced engineering, laboratory, precision manufacturing and complete service facilities are available for producing and servicing Bendix hydraulic pumps. This assures you of a quality pump manufactured specifically for your application.

All pumps are assembled and tested in a new air-conditioned, humidity-controlled, dust-free area assuring contaminate-free pumps as delivered.

MAJOR PRODUCTS—aircraft and missile hydraulic pumps; hydraulic components and sub-systems; engine fuel pumps and fuel system components; precision bellows and bellows assemblies; thermostats and related sub-assemblies; and sub-contract manufacturing and brazing.

Hamilton Division
HAMILTON, OHIO

Bendix
AVIATION CORPORATION

obtained from external sensors, like an IAS indicator, Doppler radar or navigation computer, and applied to the servo motor which rotates the lower half of the outer sphere at a proportional velocity.

To display fly up, down, left, right commands from a flight director or fire control system, the Waldorf indicator uses a tiny pivoted wedge-shaped element mounted directly in front of the concentric spheres to provide the illusion of a flight path stretching out from the airplane into space. This flight path indicator can be tipped 30 deg. up, down, left or right and also can be rotated, corresponding to a roll command, through 360 deg.

Altitude command is displayed by a small flag located at the nine o'clock position along the rim of the indicator. The flag is operated by direct current galvanometer movement.

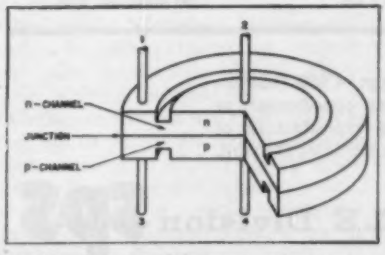
Integral lighting is used throughout the instrument. Lamps mounted inside the innermost sphere provide necessary illumination of markings on the spheres. The pilot can select either white or red lighting.

A Fresnel lens system collimates the image of the sphere and flight path indicator to prevent parallax and to give the pilot the illusion that the indication is located at infinity. The present lens system limits the angle from which the pilot can view the instrument to nearly a head-on position.

Field Effect Tetrode Combines Functions

New York—Novel semiconductor device, called the field effect tetrode, which can perform a number of electronic functions that previously required elaborate circuitry or else couldn't be performed at all, has been developed by Bell Telephone Laboratories.

New device can be made to function as a transformer, gyrator, isolator, nondistorting modulator or a short-circuit stable negative resistance. It is another example of what is becoming known as "intrinsic solid-circuitry," or "molecular electronics" (AW April 27, p. 54).



FIELD effect tetrode's construction.

The field effect tetrode consists of a disk of semiconductor material with a diffused junction in which a circular trench is cut into each face. Depth of the trench extends to within about one mil of the junction. Two leads are attached to each face, one inside the trench, the other outside.

When a voltage is applied across the junction, the thickness of the depletion layer adjacent to it is increased or decreased, depending upon bias voltage polarity. This in turn increases or decreases the resistance of each channel between the bottom of the trench and the junction.

The device has no direct analog, either in tubes or conventional transistors, BTL says. It functions either as a transformer, without d.c. isolation, or as a gyrator, depending upon the bias voltage polarity. One interesting possible application of the gyrator function is impedance inversion, which suggests the device could be used to make a semiconductor capacitor appear to be a high-Q inductor—a circuit function not previously obtainable with semiconductors. When properly biased, the device functions as an isolator, allowing passage of alternating current only in one direction.

Another promising application of the new field effect tetrode is as a distor-

29½ LBS. of Big LIFT!

HAYDU RESCUE HOIST

- Pint size 29½ lb. Rescue Hoist — can lift 600 lbs. with ease!
- Universally adaptable — equipped with hydraulic motor, AC motor, or DC motor.
- Rugged, durable hoist has anti-fouling level-wind mechanism, guillotine cable cutter, rubber rollers, up-and-down limit switches.
- Equipped with 100 ft. of usable non-twist stainless steel cable.
- Built-in provision for communication between 'copter and rescue party.
- Rated speed — 100 fpm.
- Hoist is aluminum construction and has numerous cargo applications!

HAYDU Industries INCORPORATED

AIRCRAFT ACCESSORIES DIVISION

PLAINFIELD, NEW JERSEY

tionless modulator or electronically controlled resistor for large signals. A relatively low-frequency control voltage

SPS RELIABILITY / *A dynamic standard of predictable performance*

5 Ways to Save Fastener Weight

New FN Featherweight locknut series combines minimum mass, outstanding performance

SPS FN-12 Series
Featherweight Hex Locknut

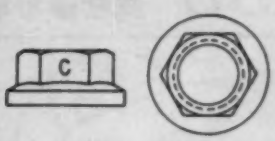
Up to 72% lighter than commonly used sheet metal or AN Series nuts. Tolerance on squareness of bearing surface to threads is 50% less than required by specification, providing reduction in stress concentration. Vibration resistance exceeds MIL-N-25027 requirements by 50%.

Characteristics

Sizes—#4 through ¼
Tensile strength—160,000 psi on 180,000 psi tensile bolt
Temperature—550°F max.
Material—Alloy steel
Plating—Cadmium

SPS Bulletin No. 2428

SPS FN-812 Series
Featherweight Hex Locknut



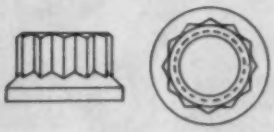
Designed for 800°F service. Corrosion and oxidation resistant; low magnetic permeability. Up to 60% lighter than conventional NAS 679 counterparts. Also less costly because made of austenitic stainless instead of A-286 super alloy.

Characteristics

Sizes—#4 through ¼
Tensile strength—160,000 psi on 180,000 psi tensile bolt
Temperature—800°F max.
Material—Austenitic stainless
Plating—Silver

SPS Bulletin No. 2521

SPS FN-22 Series Featherweight
12-Point External Wrenching Locknut



Static strength capable of breaking a 220,000 psi tensile bolt. Lightest locknut of this strength available in sizes #10 through 1½. Exceptionally close tolerance on bearing face squareness gives up to 30% longer bolt fatigue life.

Characteristics

Sizes—#10 through 1½
Tensile strength—220,000 psi
Temperature—550°F max.
Material—Alloy steel
Plating—Cadmium

SPS Bulletin No. 2487

SPS FN-920 Series Featherweight
12-Point External Wrenching Locknut

900°F locknut designed for use with high-strength engine bolts having 0.003 in. reduced pitch diameter. Close control of squareness between bearing face and threads makes these the only standard nuts for their temperature meeting squareness requirements of MIL-N-7873.

Characteristics

Sizes—#10 through ⅜
Tensile strength—200,000 psi
Temperature—900°F max.
Material—AMS 6304
Plating—Nickel-cadmium, Silver

SPS Bulletin No. 2504

SPS FN-1216 Series Featherweight
12-Point External Wrenching Locknut

Offers 160,000 psi tensile at room temperature; 140,000 at 1200°F. Reduced stress concentrations achieved by maintaining 0.003 in. bearing face squareness. Simulated service tests document high lock retention during repeated 100 hr. exposure to 1200°F while stressed to 90,000 psi.

Characteristics

Sizes—#10 through ¾
Tensile strength—160,000 psi
Temperature—1200°F max.
Material—SPS-M-118 (A-286)
Plating—Silver

SPS Bulletin No. 2488

Extensive laboratory tests have been conducted on each design of SPS Featherweight series locknuts to insure their meeting or exceeding specification or application requirements. For bulletins or samples, write SPS—manufacturer of precision threaded fasteners and allied products in many metals, including titanium.

AIRCRAFT/MISSILE Division SPS

JENKINTOWN 3, PENNSYLVANIA • SPS WESTERN, SANTA ANA, CAL.

tionless modulator or electronically controlled resistor for large signals. A relatively low-frequency control voltage can be used to vary the width of the depletion layer and thus the resistance of the device. If a high ratio of signal to control frequency is employed, simple capacitors functioning as a high-pass filter can be used to isolate one from the other so signal voltage does not appear across the junction, BTL says. This means the output signal can be very much higher than control voltage without being distorted by self-modulation.

When only the inner lead of one face and the outer lead from from the other are used, the device functions as a two-terminal a.c. short-circuit stable negative resistance. In experimental model, using boron-doped silicon crystal with phosphorous diffused junction, Bell has achieved this circuit function over a range of 30-250 v. at 0.6 to 0.1 ma.

Expansions, Changes In Avionics Industry

Bio-Physical Research Instruments, Inc., is new company formed to develop electronic instruments to measure human state of consciousness in manned space vehicles and aircraft. New company, a subsidiary of Ruska Instrument Corp., is headed by Walter Ruska, president, and C. D. Varner, executive vice president. Company's address: 6121 Hillcroft, Sharpstown Industrial Park, Houston, Tex.

Other recently announced expansions, mergers and changes in the avionics field include the following:

• **Electronic Specialty Co.**, Los Angeles, has purchased **Electrical Engineering & Manufacturing Corp.**, Los Angeles, producer of a.c. and d.c. motors. Combined company will have annual sales of about $7 million. Frank Gindroz continues as general manager of Eemco which will operate as division of Electronic Specialty Co.

• **Varian Associates**, Palo Alto, Calif., has acquired an 80% interest in **Bomac Laboratories, Inc.**, Beverly, Mass., both producers of microwave components. Bomac will continue to operate as a separate unit, headed by its original founders, who join Varian board of directors.

• **Northrop's Nortronics Division** will build a $4 million engineering, research and pilot production facility. Occupancy is slated for mid-1960.

• **Grumman Aircraft** will start construction shortly on its $4 million avionics systems center, a 55,000 sq. ft. structure, to be used in development, evaluation and testing of avionics systems for aircraft and missiles. Completion is slated for late this year.

• **Piasecki Aircraft Corp.** has opened

Difficult Teflon* & KEL-F† Moldings Offer No Problems

Our specialty is precision molding where close tolerances, intricate shapes, and where thin wall sections are involved. Garlock's United States Gasket Plastics Division has the personnel, the facilities, the unequalled experience in handling tough fluorocarbon plastics.

Guarantee yourself the best parts, and the right price—ask for a quote on any molding problem concerning TEFLON T.F.E. and KEL-F. Call us, too, for fluorocarbon sheets, discs, tape, rods, tubing, bars, and cylinders from the world's largest and most complete stock.

United States Gasket

For Prompt Service, contact one of our 30 sales offices and warehouses in the U.S. and Canada, or write The Garlock Packing Company, Palmyra, New York.

*DuPont Trademark for T.F.E.-fluorocarbon resin
†M.M.&M. Trademark

Plastics Division of GARLOCK

new 65,000 sq. ft. Mayfield Electronics

• **Hoffman Electronics** has established

work in the fields of the future at NAA

ELKTON
REDSTONE
LONGHORN
THIS IS THIOKOL...
TRENTON
DENVILLE
serving industry and the national defense
In modern plants strategically situated throughout the country, Thiokol is making many significant contributions to the art and science of rocketry.
By developing new and better propellants (both solid and liquid) — by designing and building improved power plants to utilize these fuels — by furnishing essential support equipment . . . Thiokol helps to strengthen the nation's defenses, helps push back our spatial frontiers.
Engineers, Scientists: perhaps there's a place for you in Thiokol's expanding organization. Our new projects present challenging problems and a chance for greater responsibility.
UTAH
BRISTOL
Thiokol® CHEMICAL CORPORATION
TRENTON, N. J. • ELKTON, MD. • HUNTSVILLE, ALA. • MARSHALL, TEXAS
MOSS POINT, MISS. • BRIGHAM CITY, UTAH • DENVILLE, N. J. • BRISTOL, PA.

new 65,000 sq. ft. Mayfield Electronics Division near Scranton, Pa., for producing and testing avionic gear.

• **The Merriam Instrument Co.** has purchased **I-L-S Instrument Corp.**, Cleveland, manufacturer of electronic instrumentation. New acquisition will be operated as a division with no contemplated change in personnel or location.

• **Pacific Industries, Inc.**, San Francisco, has purchased business and assets of **Computer-Measurements Corp.**, North Hollywood, Calif. No change of location or personnel is planned for newly acquired division.

• **Rheem Manufacturing Co.** and group headed by Dr. E. M. Baldwin will form new company to develop and produce semiconductor devices, according to present plans. Baldwin, former general manager of Fairchild Semiconductor Corp., will be vice president and general manager of the new Rheem subsidiary to be located in San Francisco area.

• **The Dalto Corp.** is name of newly formed company that will manufacture Dalto Visual Flight Simulator Attachment which gives visual pattern of approach and runway lights for use with flight simulators. Ward D. Davis is president of new company, Herbert Chernin is vice president. Address: Hotel Continental, New York International Airport.

• **Hoffman Electronics** has established its new Hoffman Science Center in Santa Barbara, Calif., pending construction of permanent facility. New division will be devoted to research in electronics field.

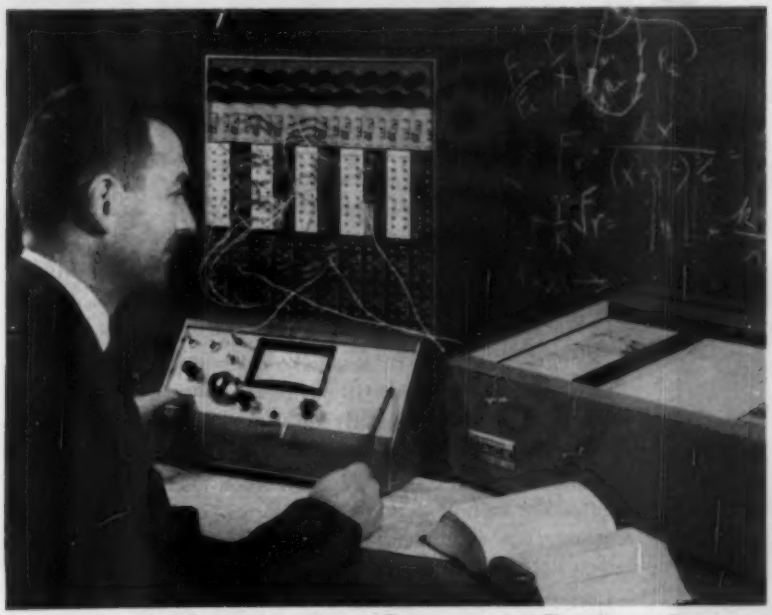
• **Ling Electronics** and **Altec**, both of Los Angeles, will merge to form Ling-Altec, with J. J. Ling as board chairman.

• **Westinghouse Electric** has set up an Anti-Submarine Warfare Project at its Air Arm Division in Baltimore, to be headed by Joseph L. Dickey.

FILTER CENTER

▶ **Satellite Weather Radar**—Meteorological satellite equipped with radar to measure severity and location of precipitation, around the globe is one long-range objective of the National Aeronautics and Space Administration. Strength of radar echo return will give indication of precipitation severity. Miniaturized version of present radar altimeters might be used for such purpose.

▶ **Arinc Air Data Computer Specification**—Airlines Electronic Engineering Committee (AEEC) will soon form a group to draw up a characteristic (specification) for an airline-type central air



Desk-Top Analog Computer Designed

Desk-top analog computer is completely transistorized but versatile enough to perform 95% of the routine mathematical operations of conventional electronic design calculations, according to Electronic Associates, Inc., Long Branch, N. J. Accuracy of the 20 amplifier TR-10 computer is 0.1%. Size is 15 in. wide, 17 in. deep, and 24 in. high; weight is about 80 lb. Readout is by meter or by an accessory X-Y plotter or digital printer. Price of the basic computer is quoted as under $4,000.

STRUCTURAL TEST ENGINEERS

NAA has immediate openings for senior engineers to work on such top-level projects as the B-70, F-108 and the rocket ship X-15.

As part of our expanding organization, you'll manage elevated temperature test projects, including planning and design; conduct tests and report results.

INSTRUMENTATION ENGINEERS

If you know instrumentation and equipment limitations, and are experienced in the design of setups, there is a career for you measuring strains, static and dynamic loads, temperatures and deflections.

Write to: Mr. A. E. Stevenson, Engineering Personnel, North American Aviation, Inc., Los Angeles 45, California.

THE LOS ANGELES DIVISION OF
NORTH AMERICAN AVIATION, INC.

THE HI-LOK AUTOMATIC FEED DRIVER, FITTED TO AN INGERSOLL-RAND AIR MOTOR, ASSEMBLES UP TO 200 COLLARS ONTO HI-LOK PINS WITHOUT RE-LOADING. ASSEMBLY RATE: UP TO 45 PER MINUTE.

HI-LOK IS BEING ASSEMBLED UNDER WING RIB IN EXTREMELY TIGHT QUARTERS USING A HI-LOK 20° RATCHET WRENCH ATTACHMENT AND KELLER AIR MOTOR.

HI-LOK IS BEING INSTALLED WITH LIGHTWEIGHT TOOLING IN PLANK SPLICE OF ELECTRA "WET" WING.

WRENCHING END OF HI-LOK COLLAR AUTOMATICALLY TORQUES-OFF WHEN DESIGN PRELOAD CONDITION IS ATTAINED DURING ASSEMBLY.

MINIMUM TOOL CLEARANCE CONDITIONS ON STIFFENERS IN WING FRONT SPAR ARE EASILY MET WITH HI-LOK ADAPTOR TOOLING COMBINED WITH INGERSOLL-RAND AIR MOTOR.

AUTOMATION OF FASTENER INSTALLATION SPEEDS ELECTRA ASSEMBLY TIME

Automatic assembly of high strength Hi-Loks up to 45 per minute, is one of many producibility factors which enables Lockheed to produce a finished Electra in only 88 days.

The Hi-Lok, because of its collar torque-off feature to automatically obtain a preload consistent within ±10%, is installed quickly and quietly with standard high speed air drivers. Torque wrench inspection is eliminated.

Manufactured in standard and precision tolerances for interference fit hole conditions, Hi-Loks come in a variety of material combinations where temperature resistance, high strength and weight reduction are design factors.

Contact your Engineering Standards Group for complete data on the new Hi-Lok fastener . . . or write to us.

TRADEMARK REGISTERED, U. S. AND FOREIGN PATENTS APPLIED FOR

hi-shear RIVET TOOL COMPANY

2600 WEST 247TH STREET, TORRANCE • CALIFORNIA

data computer. Interested air data computer manufacturers may contact William Carnes, Aeronautical Radio, Inc., 1700 "K" St., N.W., Washington, D. C., for further information.

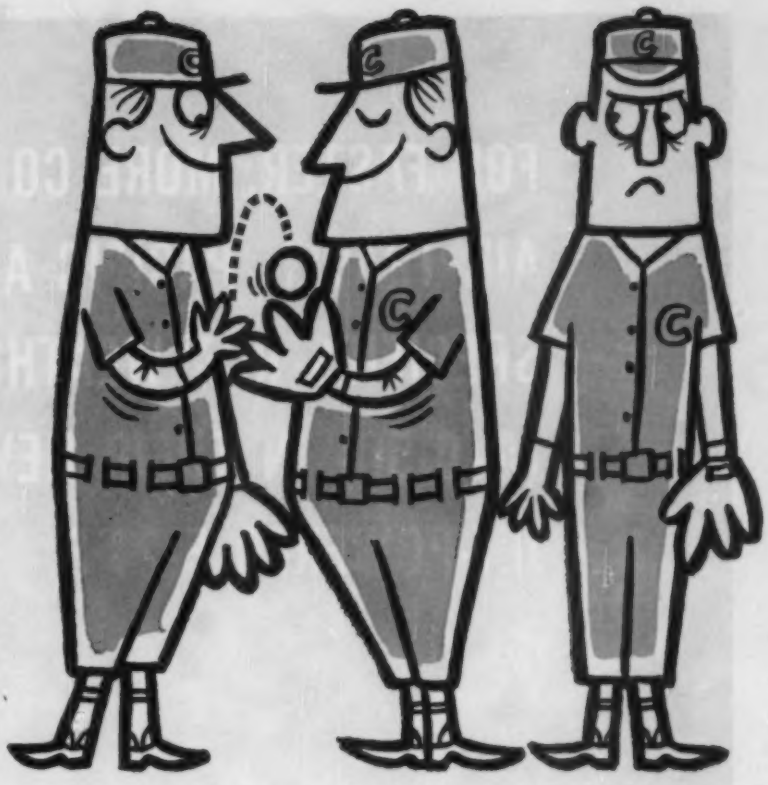
▶**Major Thermoelectric Program**—Westinghouse Electric will design and construct a thermoelectric generator capable of producing 5,000 w. of electric power for Navy Bureau of Ships under a recently awarded contract. The device, believed to be the largest thermoelectric generator yet attempted in the U. S., will convert heat directly into electricity without moving parts.

▶**Aerojet Spots Near-Misses**—New system for measuring relative trajectory, velocity and distance by which a missile misses a target drone has been developed by Aerojet-General under Navy Bureau of Aeronautics sponsorship. The system, called Firetrac, is a phase-comparison system operating in the VHF telemetry band. Airborne elements, weighing 20 lb., are installed in drone. System is being used in both Navy and Air Force drone programs, Aerojet-General says.

▶**High-speed Semiconductor Switch**—A silicon P-N-P-N controlled switch, which functions similarly to controlled rectifier but at higher switching rates, has been announced by Solid State Products, Inc. Unlike a conventional transistor, the device requires only brief pulse to turn it on. New device provides current gains of 500 and power gains of 250,000 at output peak current levels as high as 1,000 ma., company says. For technical details, write company at One Pingree St., Salem, Mass.

▶**Authors Wanted**—Fifth National Communications Symposium, Oct. 5-7, to be held in Utica, N. Y., is seeking technical papers. There will be two days of unclassified sessions, followed by one day of "Confidential" papers. Prospective authors should submit 150-word abstracts by June 30, along with a brief biographical sketch, to Mr. Ralph L. Marks, Technical Program Chairman, Griffis Air Force Base, New York.

▶**Russian Atomic Clock**—Soviet scientists have developed an ammonia Maser frequency standard, with stability equivalent to a clock that loses only one second in 300 years, according to recent Russian article. Device will be used for extra-long-range radar, improved radio transmission and for physical measurements, Soviets report. Digest of article appears in recent issue of "Information on Soviet Block International Geophysical Cooperation—1959," a weekly review of scientific activities under IGY-extended. Publication is available from Office of Technical Services, Dept. of



from Tinker to Evers

. . . leaving nothing to Chance*

Talk about double-play combinations. Rene 41 comes to us from GE. We form it and weld it into jet aircraft engine rings. Then we ship out the rings. To whom? To GE.

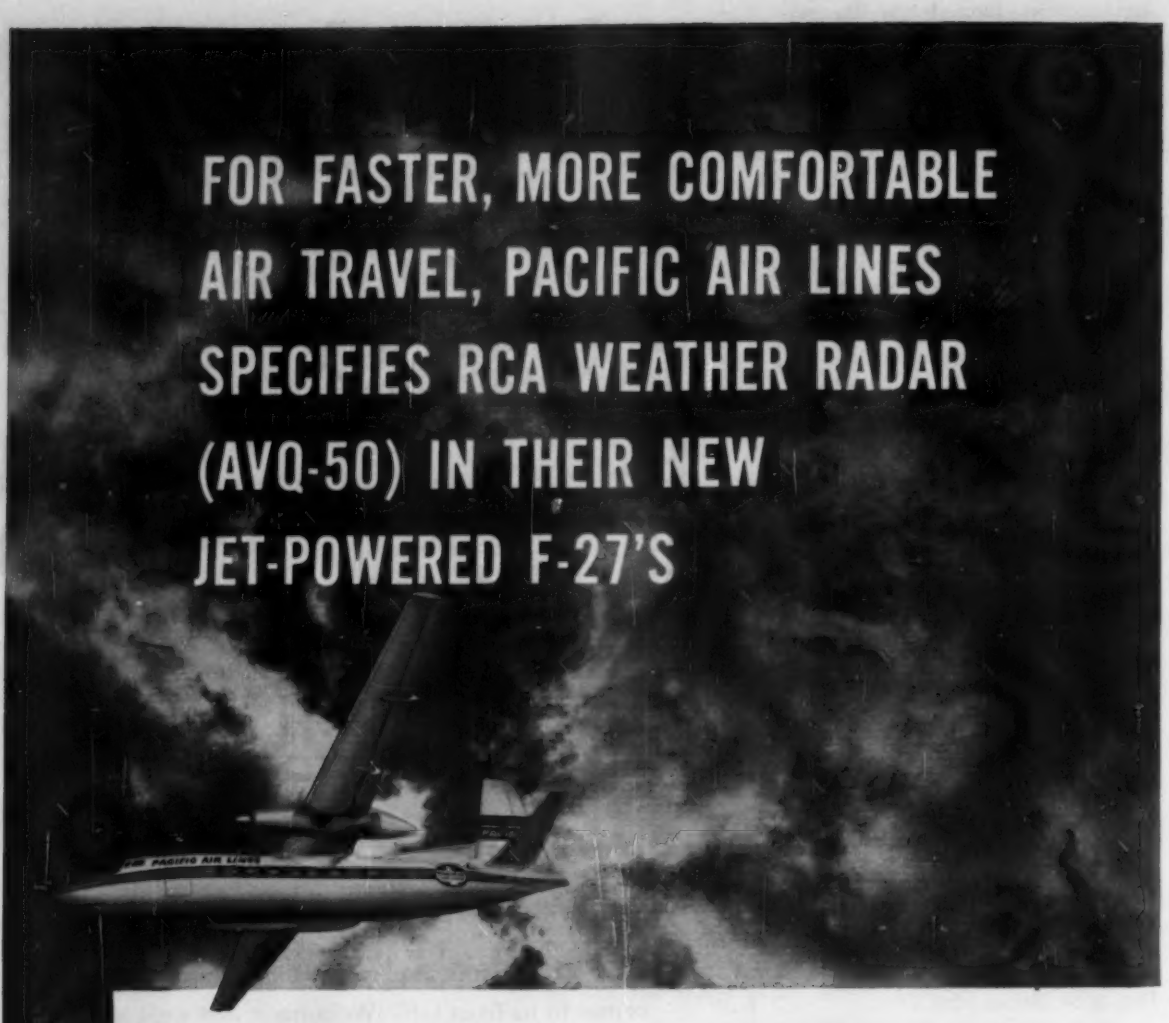
King takes pride in the fact that it is among the very few ring makers who can come to grips with this high temperature alloy.

Perhaps our facilities can serve you . . . from one ring to thousands.

*(King's physical and chemical testing laboratories make sure nothing's left to chance)

King
FIFTH WHEEL CO.
P. O. BOX 760
WILKES-BARRE, PA.

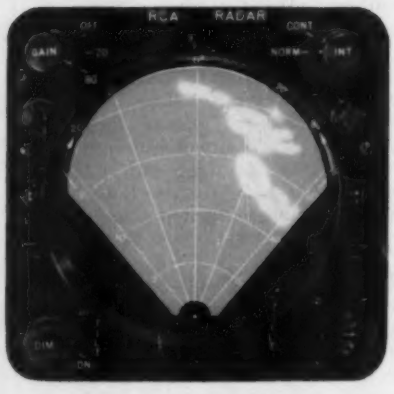
FOR FASTER, MORE COMFORTABLE AIR TRAVEL, PACIFIC AIR LINES SPECIFIES RCA WEATHER RADAR (AVQ-50) IN THEIR NEW JET-POWERED F-27'S



RCA is happy to compliment Pacific Air Lines on its new Jet-Powered F-27's. For these magnificent airplanes, Pacific Air Lines has specified RCA's AVQ-50 weather radar.

With the AVQ-50, the pilot achieves a new independence of the weather. It not only "pictures" the weather as far as 80 miles ahead, night or day and under IFR conditions, but points out non-turbulent paths through or between areas of storm and heavy precipitation, often avoiding long and costly detours. The ground-mapping property of the AVQ-50 makes it valuable for recognizing landmarks under adverse conditions and for checking normal navigation methods.

Thus Pacific Air Lines, Fairchild and RCA combine their efforts to produce air travel in its most modern sense—comfortable—swift—dependable.



RCA

RADIO CORPORATION of AMERICA

CUSTOM AVIATION EQUIPMENT

11819 W. OLYMPIC BLVD., LOS ANGELES, CALIF.

Commerce, Washington 25, D. C. Subscription for all 1959 issues is priced at $12.00.

▶ **Florida Electronics Directory**—List of Florida companies engaged in development and/or manufacture of aircraft, missiles, electronics and scientific instruments and their products is contained in a directory compiled by Florida Development Commission, Industrial Service Division. For copies, write to Industrial Services Division, Tallahassee, Fla.

▶ **Power Behind Voice to Venus**—Giant klystron tube, produced by Eitel-McCullough, Inc., powered the Massachusetts Institute of Technology's radar which recently established contact with planet Venus, company reports. The super-power klystron, developed under Rome Air Development Center sponsorship, currently is in production. Eimac klystrons also will be used for NATO's new tropospheric scatter communications network, the company says.

▶ **Signed on Dotted Line**—Major contract awards recently announced by avionics manufacturers include the following:

• **Kollsman Instrument Corp.**, $12 million from Air Materiel Command, for additional production of Astro Compasses.

• **I-T-E Circuit Breaker Co.**, Philadelphia, two contracts from Bendix Radio totaling more than $1 million for radar antenna systems. Antennas are prototypes of new early warning radar for use on DEW Line. Reflector will measure 60 ft. wide, 25 ft. high.

• **Consolidated Systems Corp.**, wholly owned subsidiary of Consolidated Electrodynamics Corp., a $348,700 contract from National Aeronautics and Space Administration, for automatic data recording and monitoring equipment for rocket engine testing at Edwards AFB.

• **Bendix Radio** reports a purchase order for more than $700,000 from Royal Canadian Air Force for airborne VOR/ILS receivers. Equipment includes new lightweight RA-21A/NVA-21A navigation systems and GSA-8 glide slope receiver, with associated indicators.

• **Electronic Communications, Inc.**, St. Petersburg, Fla., $2 million increase in contract authorization from Hughes Aircraft for communications and data link systems.

• **Bogue Electric of Canada, Ltd.**, Ottawa, $300,000 for power supplies from Burroughs Corp. for use in latter's AN/FST-2 SAGE data processing equipment.

• **Marquardt Aircraft Co.**, Pomona Division, $2 million USAF contract for AN/GPS-T4 radar signal simulators for training Air Force intercept controllers.

HADLEY

missile valves & controls

If you want to keep that project on schedule . . .

You need motivation to get performance. Hadley has that motivation with sound engineering, environmental testing, precision manufacturing and rigid quality control.

In addition, Hadley offers performance . . . the ability to design, develop and deliver the quality product on schedule.

For more information write, J. T. Reilly, Director of Marketing.

Pioneers in Cryogenic Valves

• **ENGINEERS: Inquire about attractive project & design career opportunities.**

B. H. HADLEY INC. *

POMONA, CALIFORNIA

*Wholly owned subsidiary of Control Hadley Corporation — listed American Stock Exchange.

COMFORT
COMFORT
COMFORT
COMFORT
COMFORT

The Apache is a big, roomy airplane – roomier by far than any other twin anywhere near its class. There's plenty of cabin width and cabin height to give each passenger ample stretch-out, spread-out room. Whether your Apache is fitted with four standard individually adjustable and reclining seats or with optional five-passenger arrangement, each person has his own separate seat with abundant head, shoulder and leg room. Passenger comfort is only part of the story. New super-soundproofing means really quiet flight. Tasteful decor and fine styling of the interior appointments add a touch of luxury. Quality is evident throughout from the genuine leather seat upholstery to the fine, washable nylon fabrics. You'll be proud to welcome aboard the most discriminating passengers...and they'll be glad you did.

FLY THE 1959 APACHE with two 160 hp Lycomings, over 170 mph cruise, excellent single-engine performance, sensational short field get-up-and-go. See the completely new instrument panel with center-mounted radios. See how the amazing, low-cost Piper AutoControl gives you hands-free automatic flight in the AutoFlite Apache. See for yourself why more Apaches are bought than any other twin. Contact your nearest Piper dealer or write for Apache catalogue, Dept. W-5, Piper Aircraft Corporation, Lock Haven, Pennsylvania.

PIPER *Apache*

ATTRACTIVE LEASE AND FINANCE PLANS

Cessna Acts to Capture Export Market

By Erwin J. Bulban

Wichita—Recent "task force" approach by a Cessna Aircraft Co. management and technical team in setting up an international export conference in Nice, France, to explore European, African and Near East business aircraft market potentials, is expected to pay dividends in boosting immediate sales and the rate of sales growth above the current curve.

Team members expressed considerable optimism about the prospects for increased sales and general improvement in business flying activity in the next few years in the areas it covered. They cited their belief that Cessna's exports in the next year could double compared with last year in the areas they visited.

EUROPEAN markets are emphasized to dealers by export manager M. F. Mellinger.

DETAILED SALES KITS, covering techniques new to many dealers, were studied at Nice.

Important Impressions

Two important impressions, which will strongly influence Cessna's future consideration of the European business airplane market, were emphasized by two of the top members of the team interviewed by AVIATION WEEK here:

• **Interest in business flying** in the European area is at approximately the same point on the curve that it existed in the United States some five years ago, according to Cessna Marketing Manager Frank Martin. Actual activity is far below the corresponding curve in the United States at that time, but to consider this aspect solely would be to miss an important point: receptivity by the potential customer is there, spurred by experiences provided by visiting U.S. businessmen, by the foreign businessman's exposure to business flying activity during visits to this country and by the increasing effect of publicity regarding executive flying as practiced in this country.

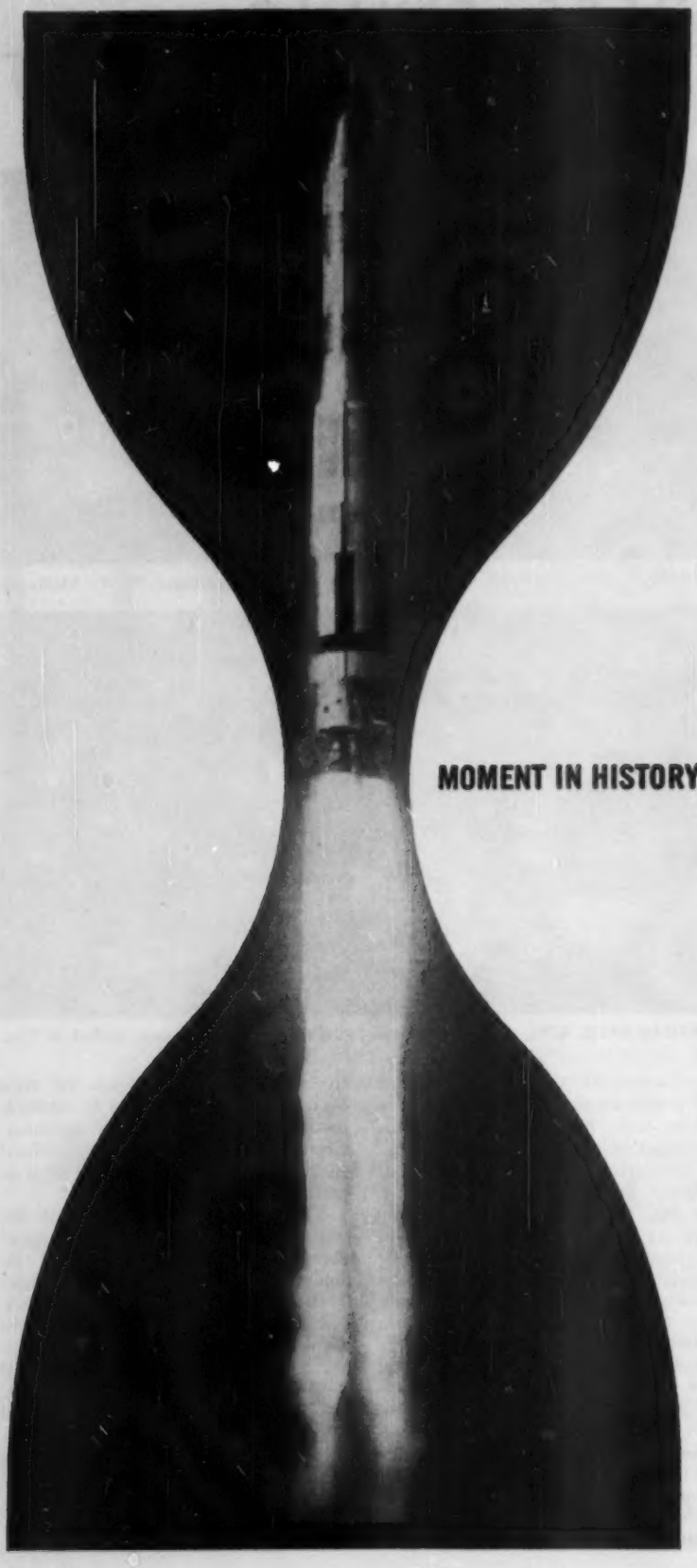
• **Fairly stiff design** competition from foreign manufacturers in the general aviation category approximately three to five years from now is being assumed by top-level Cessna personnel as a result of a study of facilities abroad during the team's visit, Del Roskam, vice president-manager of the commercial aircraft division said. Currently, European general aviation aircraft are considerably backward compared with contemporary U.S. designs, he noted. This disparity is primarily due to overseas designers emphasizing one particular performance feature over all others, which has resulted in their airplanes having very limited utility. United States light aircraft designers have learned to combine speed, range, effective payload, comfort, and small-field operating characteristics, making some compromises to provide maximum utility, Roskam noted.

Considering that European aircraft designers do not lack technical know-how and that their plants are getting more and more modern production equipment, Cessna says that it must consider that they will take heed of the growing market and build airplanes more compatible to business aviation. In fact, some foreign firms have already indicated strong interest in building U.S. designs under license.

For the next few years at least, Cessna feels that U.S. manufacturers must establish themselves firmly in this area by building strong distributor-dealer organizations to the levels of those in this country. When the European manufacturers become a strong competitive factor, the groundwork will then be ready for U.S. builders to establish production plants abroad, if necessary. Cessna already is studying the problems entailed in developing such facilities as part of its long-range planning.

The Cessna team that went to the company-organized international export management conference in Nice included commercial export manager M. F. Mellinger; Del Roskam; commercial aircraft chief engineer Jerry Gerteis; Frank Martin; export regional sales manager Dallas W. Cederberg, and regional service manager Paul Bollman.

The three-day meeting was attended by about 30 Cessna dealers and prospective dealers and covered marketing and sales concepts, design philosophy, current product line, advertising, sales promotion, publicity, service and financial procedures. The company's com-



MOMENT IN HISTORY

THIS IS THE "FIRST FLIGHT"

of the new Air Force TITAN, America's most powerful weapon and our No. 1 challenger in the big-missile field. Time: 2/6/59—4:22 p.m. EST.

The most important thing about this moment in history is not visible here—and it is this:

Three years to the day from the breaking of ground at Martin-Denver, TITAN No. 1 roared into the sky. Those 36 months saw the creation of the free world's most advanced ballistic missile facility—and the development, production, testing, delivery and launching of the first of an entirely new *generation of ballistic missile weapon systems, forerunner of the Global Ballistic Missile.*

TITAN is the result of an advanced engineering concept—developed by Martin under the direction of the Air Force's Ballistic Missile Division of the Air Research and Development Command—which provides the most extensive pre-flight testing of components, subassemblies and full scale missiles ever undertaken.

This method in the TITAN development, and in the generations of space systems to follow, may well be one of the most important single factors in speeding America's bid for space supremacy.

Martin-Denver
is one of the
seven divisions
of The Martin Company

MARTIN
BALTIMORE·DENVER·ORLANDO

plete 1959 line of business airplanes was taken along and used for demonstration purposes.

For many dealers this was their first exposure to the latest techniques developed by the company and their first opportunity to discuss problems with company people and mutual problems with one another. This opportunity provided a cross-exchange of information that will speed development of the dealer organization by many years, Martin said. This close contact, plus expressed interest of many dealers to establish closer liaison with the factory will result in the foreign sales outlets jumping the long learning curve experienced here and starting out with mature techniques, he noted.

As an indication of how interest in business flying is taking hold abroad, Martin noted that probably more foreign dealers and other visitors have come to the company's Wichita plant the past two years than in the previous decade.

To maintain these close ties Cessna is immediately putting a full-time service representative on assignment to work with its European area dealers, to aid them in setting up facilities and solving problems. The man assigned to this duty will be based at the factory, and spend some 60% of his time traveling abroad. The company believes this system will prevent the man from losing touch with the latest developments and will keep him from getting stale. A full-time sales representative will also be assigned to cover the area.

Meeting in Nice

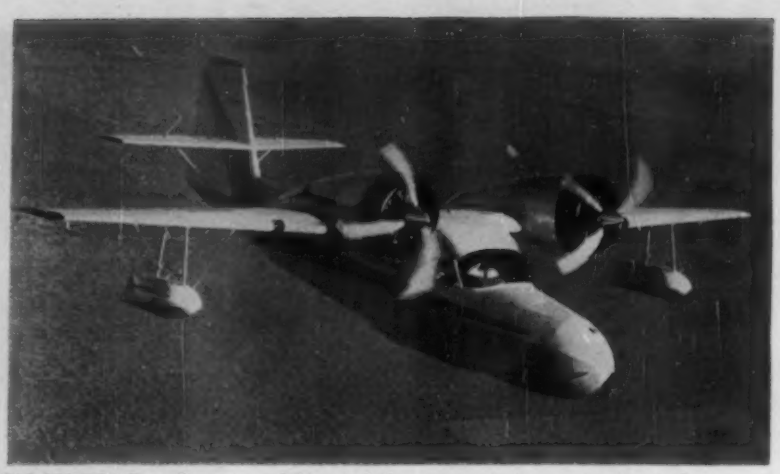
A big problem in developing additional interest in the company's products is that as yet few airplanes are being used in the area, subsequently there are many prospects who have never even seen one of its airplanes. This was particularly pointed up during a tour made with the 310C demonstrator, following the meeting in Nice, which has logged some 200 hr. at taking interested prospects and local prominent persons aloft. Indications are that a number of 310 sales directly attributable to these showings will result. Martin ventured that as a result of the trip to Europe, Cessna can expect to double its 310 sales this year in that area compared with total sales in the past five years.

In order to maintain this exposure, he stated that the company representatives assigned to foreign sales and service in the future will take along different airplanes of the various models for their use as they tour the areas.

Members who attended the export conference abroad expect that it will have the same impact in developing the dealer organization that has been experienced following a similar meeting

in the South American area: numbers of outlets increased as a result of attendance at the sessions, information exchange resulted in dealers developing their facilities and expanding their services, and team spirit engendered at the meetings led to greater cooperation among dealers with benefits to all. Concrete results of the past year's meeting could be noted during each succeeding visit, Martin stated. Enthusiasm reported among the dealers at the Nice meeting indicated that similar facilities expansion will be undertaken in the year to come.

As an example of how the meeting helped expand the sales outlet problem in Europe, Martin noted that now the company's Athens sales representative plans to expand his facilities and become a full-fledged dealer. He forecasts that if this man follows through on plans he outlined during the meeting he may become a distributor. As an indication of the progress this spells in that area, Martin noted that the company has never sold in Greece—facilities have been so lacking that arrangements had to be made for an airline pilot to teach the sales representative to fly. The country has a good potential, indicated during the 310 demonstration flights made in Athens where 150-200 top people in the city were given rides.



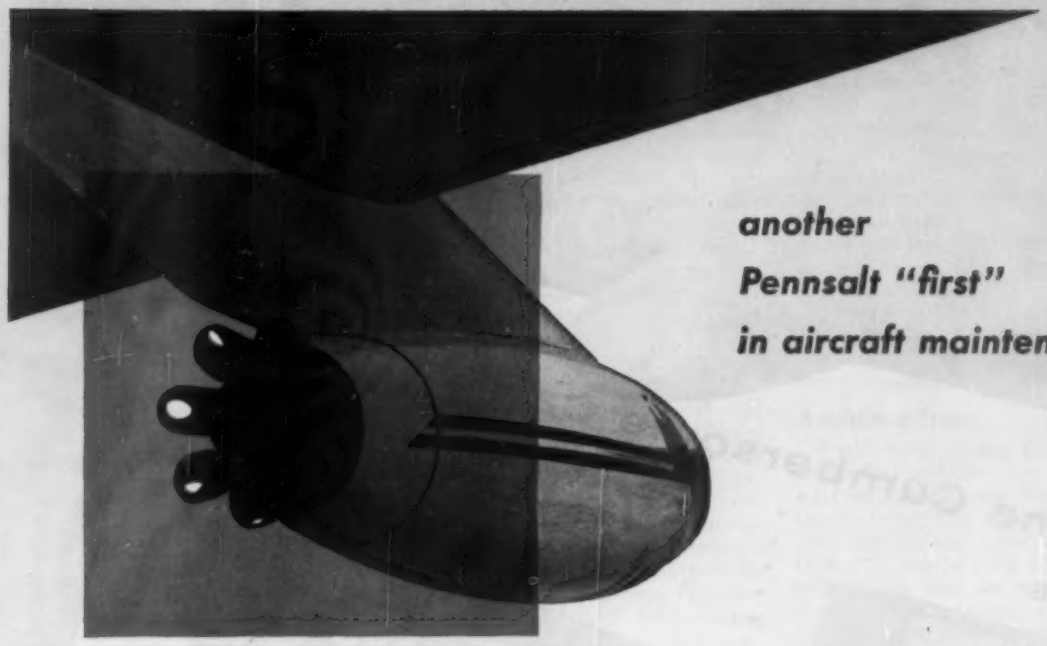
$89,950 FOR Pace Gannet amphibian includes communications-navigation package.

Radial Engines Power Widgeon

Burbank, Calif.—Production program for a six-passenger modification of the Grumman Widgeon amphibian, powered by 300-hp. radial Lycoming engines, has been established by Pacific Aircraft Engineering Corp. (Pace) at Lockheed Air Terminal here.

The Pace conversion provides the airplane with a cruise speed of 170 mph. at 66% power at 8,000 ft. with gross weight of 5,500 lb., the company reports. Other prime performance characteristics include 10-sec. takeoff from water at full gross weight and climb of 1,850 fpm. and single-engine ceiling at this weight of 8,000 ft.

Price of the equipped conversion, incorporating some 34 major refinements,



another
Pennsalt "first"
in aircraft maintenance

New Delchem cleaner-descaler cleans jet engine hot section parts safely, effectively

Removing the heat scale and carbonaceous deposits which are seared on hot section parts of jet engines by 1500-degree temperatures has been one of the toughest problems of jet maintenance. A new cleaner-descaler . . . Delchem 2128A . . . now makes it possible to get thorough cleaning for inspection and for renewing operating efficiency, without danger of mechanical damage or corrosion to metal components.

The new material was developed by Pennsalt specialists in descaling compounds, paint strippers and other compounds used widely in military and commercial aircraft maintenance. It is applicable both to turbo prop and turbo jet engine parts such as combustion chambers, inner liners, crossover tubes, turbine nozzles, rotors, blades, exhaust components and afterburners.

Dipping the critical parts in hot Delchem 2128A solution, followed by another bath and rinse, quickly removes the toughest soil and scale. The material meets or exceeds all detailed requirements of specification MIL-D-26549 (U.S.A.F.).

Delchem 2128A is a homogeneous alkaline liquid. Its viscosity is amply low to minimize drag-out loss. It is nonphenolic, nonflammable, and completely water-rinsable. It is safe on high temperature alloys.

For information and consultation, write to Pennsalt Chemicals Corp., P. O. Box 543, Riverdale Station, Dayton, Ohio; 2700 S. Eastern Ave., Los Angeles 22, California; or 9009 Sovereign Row, Dallas 35, Texas.

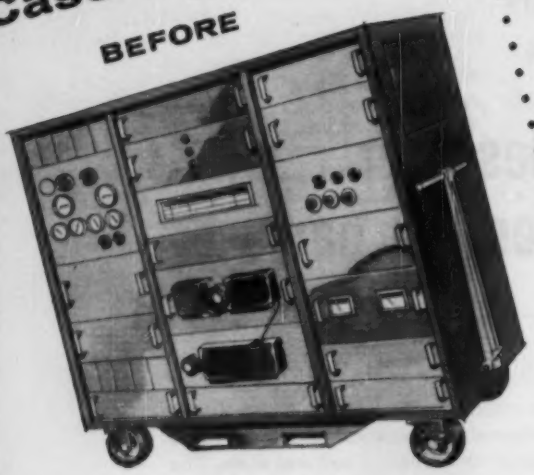
"...a better start for your finish®"

Metal Processing Department
PENNSALT CHEMICALS CORP.
3 Penn Center, Philadelphia 2, Pa.

Pennsalt Chemicals
ESTABLISHED 1850

Case of the Cumbersome Cart

BEFORE



AFTER

THE PROBLEM:
An electronic checkout cart, complete with installed electronic gear, was impractical for field use. Top heavy construction, no provisions for heating, cooling, or cable storage plus bulk size and poor mobility resulted in a "Cumbersome Cart."

THE SOLUTION:
After careful study of the cart and its proposed function, Defense Products Division engineers came up with a completely different design — compact and functional. The new cart, ready for successful use, moves easily on large balloon tires. All installed equipment is shock mounted and is automatically refrigerated or heated for precision readings in a wide ambient range. Efficient performance is assured by filtered air inlets, light weight, and 1,000 hour reliability. Plug-in components allow easy servicing. Our new design permits complete integration with a variety of weapons systems.

Another example of the many ways AAF is working with prime contractors on problems of Ground Support Equipment. Write today for free literature illustrating other examples of DPD's engineering excellence.

Write today for our
FACILITIES BROCHURE

AAF
American Air Filter
COMPANY, INC.
DEFENSE PRODUCTS DIVISION
ROCK ISLAND, ILLINOIS

Specialists in Packaging Electronic Equipment

Pace Gannet

Gross weight	5,500 lb.
Useful load	1,700 lb.
Maximum speed (sea level)	190 mph.
Cruise speed (66% power @ 8,000 ft.)	170 mph.
Rate of climb (sea level)	1,850 fpm.
Landing speed (gross weight)	62 mph.
Water takeoff time (gross weight)	10 sec.
Single engine ceiling (gross weight)	8,000 ft.
Fuel capacity	158 gal.
Range	1,000 mi.

and standard equipment including instrument flight panel, is $89,950. Panel installation includes a Lear Navcom 100, Lear Navpak 100 and Lear ADF-12 with gonio-indicator and gonio-type antenna.

Present schedule calls for converting 15 Pace Gannets from zero-time French-built SCAN-30 Widgeons; the company also has a program to convert existing Widgeons to Gannet configuration in 30 days, according to Vice President-General Manager Charles H. Harris.

Modification program includes rebuilding the existing hulls by installation of five watertight compartments, two longitudinal steps in the hull, new up-lock mechanism for main and tail landing gears, escape hatch and new hydraulic and electrical systems. Electrical system has 50-amp. generator and booster coil for cold starts. Entire trailing edges of the wings are removed and replaced with new ribs; wings are all-metal covered and flush riveted. Auxiliary fuel tanks of 25-gal. capacity are located in the wings.

Lycoming R-680-E3 powerplants are fitted with pressure cowlings with over-the-wing augmented exhausts. Engine modifications include straight-through push-rod housings and revised nose cones with new engine crankcase venting systems. Engines have chrome-plated cylinders and Neoprene-covered ignition harness. Oil system provides two six-gallon vented tanks. Propellers are three-blade Hartzell full-feathering types.

Beech Designs Modernization Kits For Super 18s, D18Ss and C-45s

Wichita, Kan.—Important performance gains are realized in early model Beech Super 18 and Model D18S and C-45 versions as a result of specially developed factory-supplied kits available now through the company's distributor-dealer organization.

Refinements developed by Beech engineers can be installed individually, in combination according to the owner's wishes, or as a complete package to provide maximum modernization. Kits are approved by Federal Aviation Agency.

• **Super 18 modernization** kit significantly increases early model E18S performance in every category and brings it up to par with new Super 18 production models, including gross weight of 9,700 lb. (AW Dec. 8, 1958, p. 112).

• **Model D18S** and military versions can have gross weight boosted to 9,000 lb., cruise speed increased more than 20 mph., METO (maximum except takeoff) power increased from 400 hp. to 450 hp., two-engine rate of climb increased by 310 fpm. (single-engine climb is up 204 fpm.), service ceiling increased by 4,100 ft. (single-engine service ceiling by 3,700 ft.). Increases reportedly are based on data furnished by customers who already have had this kit installed. Some of the modifications for the basic Model 18 include new features incorporated on 1959 model Super 18s.

Hartzell three-blade propeller kit, which replaces two-blade Hamilton Standard propellers, is priced at $5,975 with anti-icing provisions and $5,725 without this latter equipment. Propellers, Model HC/B3230-2D/10160-B-6, are especially designed to Beech requirements and feature heavier, 10% thicker blades than previous Hartzell three-blade propellers, some of which have been installed at modification centers prior to the Beech-approved kit. Thicker blades were felt to provide the ruggedness needed when drawing full power out of the Twin Beech's 450-hp. Pratt & Whitney R1340 engines—another feature is that they use ball bearing type retention in the hub compared with the previous split-ring retention system on earlier Hartzell three-blade props. Three-blade prop installation also provides some 40% reduction in vibration in cabin area compared with the Hamilton Standard installation, noticeable lowering of noise and reduced crankshaft stresses.

Additional Items

Other items in the Beech modernization kits include:

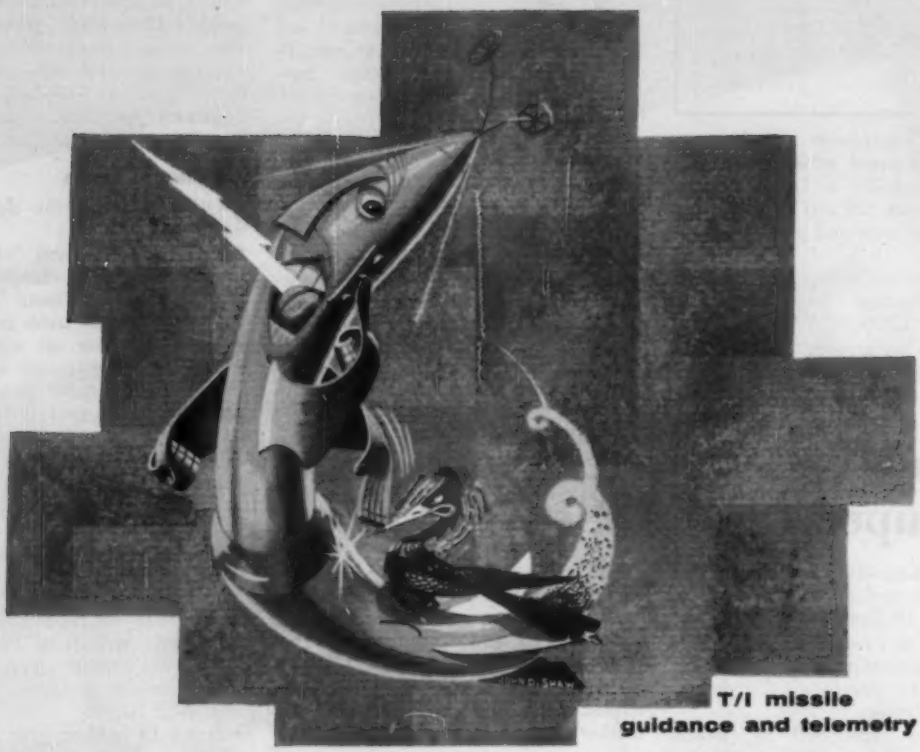
• **Jet stack installation** ($4,275), triple-tube type reducing manifold back pressure and pulling more air over the engine to provide extra cooling.

• **Carburetor ram air scoops** ($1,090) which provide increased manifold pressure to allow more power. Ram air pressure is increased at the carburetor deck, decreasing the amount of thrust horsepower used to operate the supercharger. A new mixture valve is designed to reduce valve icing.

• **New cabin heating** systems, a "super" 90,000 Btu. Janitrol installation for the right wing or a layout of two 40,000 Btu. units with Stewart-Warner heaters mounted in the wheel wells. Both systems have defrosting equipment and blowers for ground operation. Big single unit is priced at $5,640 and the dual system at $2,995.

• **Super 18 landing gear doors** permit-

BEECH 18 has three-blade Hartzell propellers and Beech-developed kits installed.



T/I missile
guidance and telemetry

BEEPS WITH A HIGH IQ

...for missile sensing, guiding and telemetering

Electronic signals that report the truth, the whole truth, and nothing but . . . wring the best performance from missile systems. By pushing beyond known capabilities in sensitivity and accuracy, Texas Instruments is producing "high IQ" systems and equipments for a dozen guided vehicles used in every basic mission: air-to-air, air-to-surface, surface-to-air, surface-to-surface — IRBM and ICBM—plus drone sensors and satellite instrumentation. ● TI exceeds tough specs against tight deadlines, regularly . . . specs asking solutions to problems never posed before. For detailed discussion, cleared personnel please write or call: SERVICE ENGINEERING DEPARTMENT.

RESEARCH/DESIGN/DEVELOPMENT/MANUFACTURING of systems for: *Air traffic control • Airborne early warning • Antimissile • Antisubmarine warfare • Attack control • Countermeasures • Missile systems Navigation • Reconnaissance • Space electronics; and on detector cells, engine instruments, infrared, intercom, microwave, optics, sonar, telemetering, time standards, timers, transformers and other precision equipments.*

APPARATUS DIVISION

TEXAS INSTRUMENTS
INCORPORATED
6000 LEMMON AVENUE
DALLAS 9, TEXAS

ting extension of gear at speeds up to 160 mph., are priced at $1,200.

• **Stabilizer angle** of incidence change, revises angle from −2 deg. to −½ deg., adding three to six miles per hour to airplane's speed through drag reduction. Additional aerodynamic stability is provided by installation of an elevator down spring. Cost of change is $340.

• **Fuel flow meter,** making possible most economical and effective power settings, is available at $1,425.

• **New cowl bracket supports,** aimed at reducing effects of engine vibration and fatigue problems. Cost of this equipment is $45.

• **Improved oil radiator** cooling air valve, permitting complete air shut-off over the oil radiator to facilitate cold-weather engine warmup, is priced at $8.

Optional kits also include revised nose to Super 18 configuration, with removable access panel. Price is $1,200. Wingtip extensions are also available, permitting improved rate of climb, decreased stall speed and more effective aileron control ($1,330); 60-gal. auxiliary wing tanks, freeing nose section for radar and radio installations $2,995); extended tail wheel raises ground height six inches to provide easier landings, improved visibility and ground handling characteristics, also levels the cabin floor to provide more comfort for passengers while plane is on the ground ($680); leading edge landing lights, including lower-intensity taxi light ($295) and new engine crankcase vent, which reduces possibility of freezing and clogging of vent and vent lines ($215).

Basic Kit

Basic kit for modernizing early Super 18s comprises new propellers, carburetor ram air scoop and auxiliary wing tanks.

New powerplants, providing increased reliability and performance, will be installed in a new model of the Cessna T-37A jet trainer in November. Installation of the later engines and revision of airplanes' current avionic equipment to improve navigation and communications facilities (AW Nov. 24, 1958, p. 113) will result in later production models being designated T-37B.

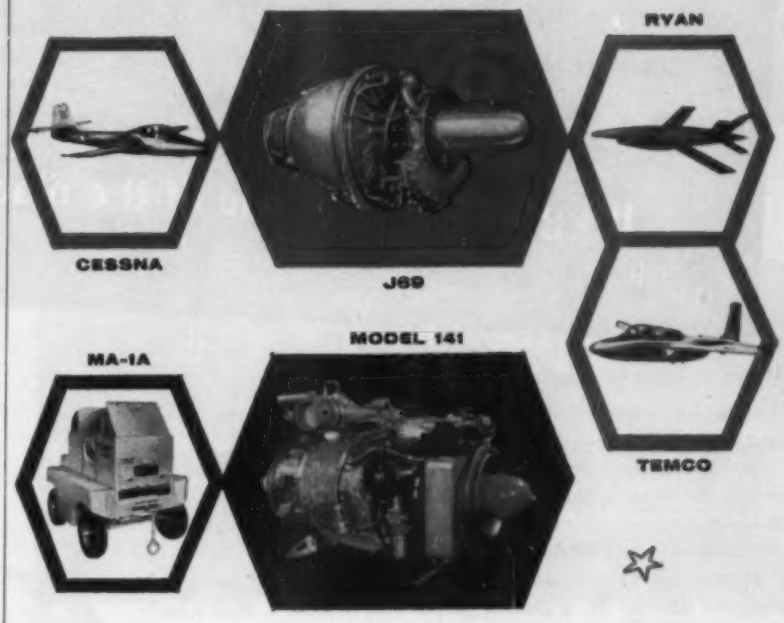
First phase of program, installation of new avionics gear, starts in June; new 1,050-lb.-thrust Continental J69-T-25 turbojets will be fitted starting in November, at which time the airplane will receive its new designation. J69-T-25s are expected to provide reduced maintenance and longer engine life than current 920-lb. thrust J69-T-9s.

Installation of new engines does not require major modifications, Cessna reports.

CAE

• RESEARCH
• DEVELOPMENT
• PRODUCTION

Building Tomorrow's Power



Continental Aviation & Engineering Corporation has more than 10 years' experience with small gas turbine engines.... Four versions of the J69 turbojet—delivering 920 to 1700 lbs. thrust—are in operation today. . . . The Model 141 turbine air compressor engine is widely used in jet aircraft ground support equipment. . . . Research and development programs are continuously in process on uprated turbines, new turbine configurations, solid fuel propellents, and solid fuel ramjet vehicles.

CONTINENTAL AVIATION & ENGINEERING CORPORATION

SUBSIDIARY OF CONTINENTAL MOTORS CORPORATION

It's great to be proud of the place you work

What makes a successful engineer?

Initiative—experience—imagination—intelligence are all important factors. But there is at least one more—enthusiasm.

Young engineers at Autonetics are *enthusiastic.* They're fired up about the projects they work on, such as the advanced inertial-navigation systems for the Polaris-carrying subs, and the guidance and control system for the Minuteman missile.

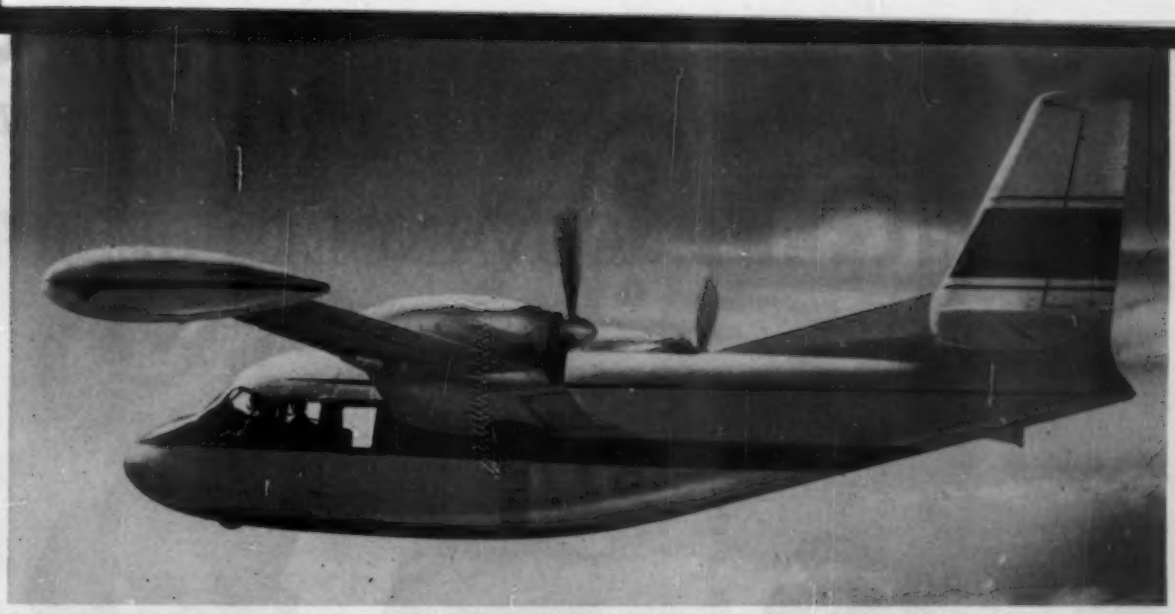
Variety sparks their enthusiasm. Autonetics' young men also designed RECOMP II, a general purpose, all-transistor, digital computer; NUMILL, a completely automatic, machine tool control system; BACE, high-speed automatic checkout equipment; and many other industrial and military products.

Today at Autonetics there is room for engineers and scientists who seek unusual creative problems in electronics and electromechanics. Please send your resume to Mr. B. E. Benning, 9150 East Imperial Highway, Downey, California.

Autonetics A DIVISION OF NORTH AMERICAN AVIATION, INC., DOWNEY, CALIF.

INERTIAL NAVIGATION / ARMAMENT CONTROL / FLIGHT CONTROL / COMPUTERS AND DATA PROCESSING

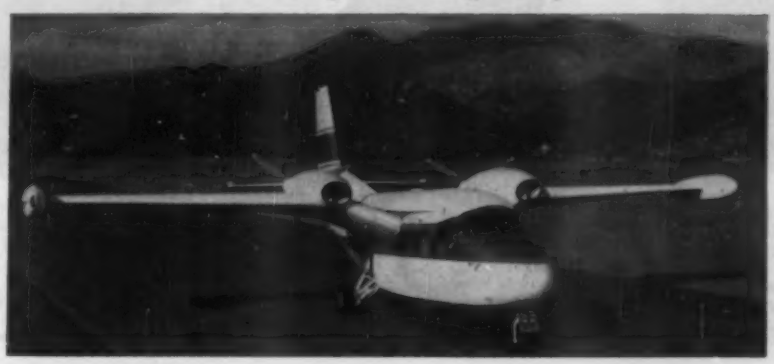
Among the achievements of Autonetics' young men: The first successful airborne all-inertial navigation system . . . first navigation system accurate enough to guide the USS Nautilus and Skate on their historic voyages beneath the Arctic ice . . . first successful automatic star tracking by an inertial navigation system during daylight flight . . . first inertially stabilized gyro platform proved operable in any kind of maneuver . . . first successful completely automatic landing system for supersonic missiles and aircraft . . . first transistorized portable digital computer with "big computer" capabilities.

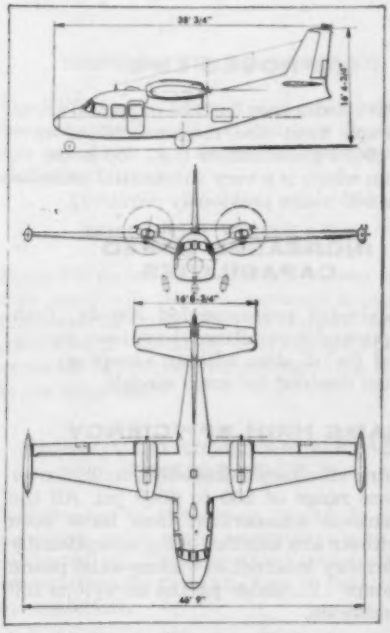


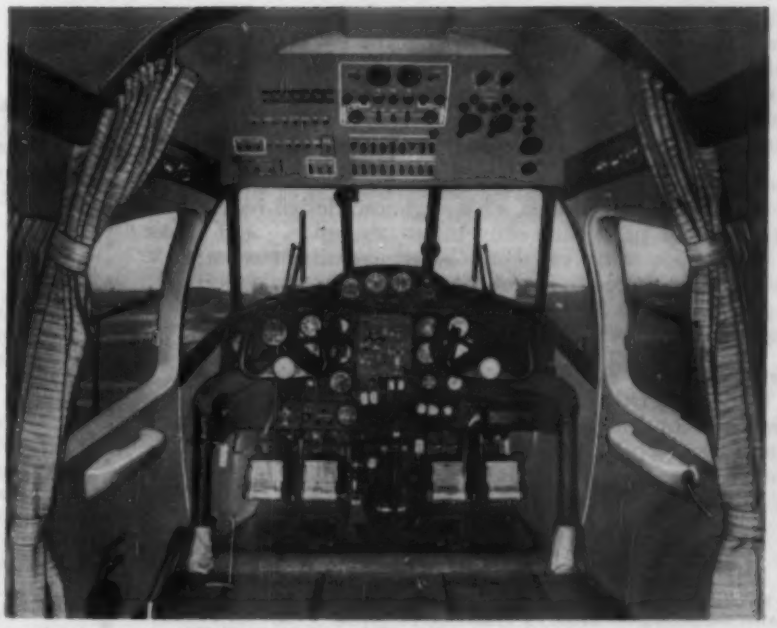
Trecker 166 executive transport is fitted for JATO. Range is about 1,200 mi. Three-blade propellers are full-feathering.

First Trecker 166 Sold to Drilling Company

First Trecker 166 twin-engine executive plane, an adaptation of the Trecker Gull amphibian, has been delivered to Drilling Tools, Inc., Houston, Tex. Aircraft is a version of the Italian Piaggio 136 and is powered by two supercharged Lycoming engines rated at 340 hp. each. Six-place plane is priced $114,500 at the factory. The airframe is built by Piaggio & Co. at Genoa, Italy; assembly and installation of the pusher engines, instruments and mechanical components is completed at Trecker Aircraft Corp.'s facility at General Mitchell Field, Milwaukee, Wis. Initial production involves 20 planes.







Aircraft's nose cowl is removable for instrument and radio repair. Pilot's compartment has separate door at right.

Design breakthrough nou

VICKERS. ADVANCED DESIGN

(PV SERIES)

Model Series	PV006
Theoretical Dspl.	.095 cu in./rev
Rated Speed	12,500 rpm
Weight	2.4 lb
Hp/lb @ Rated Speed	3.8
Bolt Spacing	1.875"
Overall Length	4⅜"

Model Series	PV012
Theoretical Dspl.	.188 cu in./rev
Rated Speed	10,000 rpm
Weight	4.2 lb
Hp/lb @ Rated Speed	3.4
Bolt Spacing	3.536"
Overall Length	5 1/32"

Model Series	PV024
Theoretical Dspl.	.367 cu in./rev
Rated Speed	8,000 rpm.
Weight	5.9 lb
Hp/lb @ Rated Speed	3.8
Bolt Spacing	3.536"
Overall Length	5⅞"

Model Series	PV039
Theoretical Dspl.	.600 cu in./rev
Rated Speed	8,000 rpm
Weight	9.5 lb
Hp/lb @ Rated Speed	3.8
Bolt Spacing	3.536"
Overall Length	6 13/32"

• "Design breakthrough" as used on this page is a carefully considered statement. Here is the lineup of the PV series fixed angle variable displacement hydraulic pumps for aircraft and missiles systems optimization. The numerous important improvements briefly discussed at the right indicate that these advanced design pumps are destined to set new standards of performance.

All series have integral automatic pressure compensator and a broad range of control methods. This advanced design requires substantially fewer parts than conventional design . . . and it has reduced to a minimum the number of external sealing elements. Now, for the first time, the power saving (and heat rejection) advantages of variable displacement are available in pumps of fixed displacement envelope and weight.

When first announced last March, only the smallest unit (Series PV006) had completed exhaustive endurance tests and was available. Now three more series (PV012, PV024 and PV039) are ready for system application. Three larger sizes are in the development stage. *For further information write for Bulletin A-5233.*

IMPROVED LIFE

Exhaustive endurance tests have proved these new pumps meet the requirement of new MIL-P-19692 specification (i.e., 750 hours at rated rpm which is a very substantial increase over the 560 hours previously required).

INCREASED SPEED CAPABILITIES

The maximum recommended speeds (both continuous and intermittent) have been greatly increased for all sizes without exception . . . more than doubled for some models.

SAME HIGH EFFICIENCY

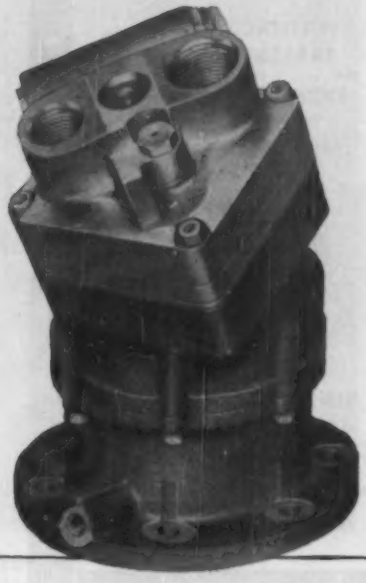
Volumetric efficiency is from 96% to 98% over a pressure range of 500 to 3000 psi. All the improvements enumerated here have been made without any sacrifice of the exceptionally high efficiency inherent in Vickers axial piston type pumps . . . under partial as well as full flow conditions.

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Aero Hydraulics Division • Engineering, Sales and Service Offices:
ADMINISTRATIVE and ENGINEERING CENTER | TORRANCE, CALIFORNIA • 3301 Lomita Boulevard
Department 1462 • Detroit 32, Michigan | P.O. Box 2003 • Torrance, California
Aero Hydraulics Division District Sales and Service Offices
Albertson, Long Island, N.Y. • Arlington, Texas
Seattle 4, Washington • Washington 5, D.C.
Additional Service Facilities at: Miami Springs, Fla.

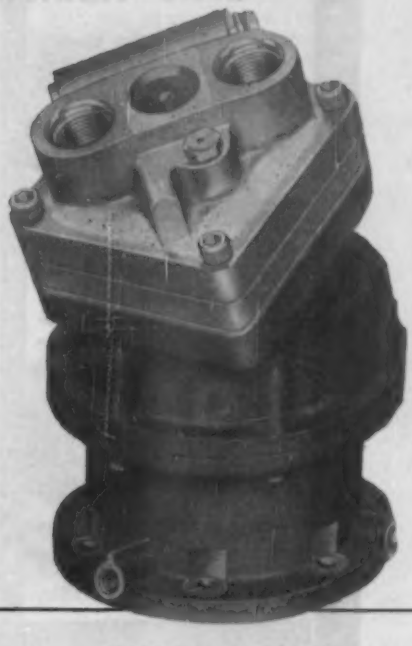
n depth!

VARIABLE DISPLACEMENT PUMPS

Model Series.....PV062
Theoretical Dspl. .950 cu in./rev
*



Model Series.....PV104
Theoretical Dspl. 1.600 cu in./rev
*



Model Series. PV153
Theoretical Dspl. 2.350 cu in./rev
*

*Similar inherent performance advancements shown for the smaller pump sizes will be carried over to these models.

IMPROVED RESPONSE

The PV006 series is capable of full flow to zero flow response in 0.02 sec and zero flow to full flow response in 0.04 sec without pressure oscillation.

MINIMUM PACKAGE

These PV series variable displacement pumps have practically the same envelope as constant displacement units of equal output. In comparison with standard variable pumps, the reduction in envelope varies from 70% to 15% as size increases.

IMPROVED CONTAMINATION RESISTANCE

Performance of these new pumps is greatly improved even when operating with contaminated oil. This improved contamination tolerance results from changes in both design and materials.

IMPORTANT WEIGHT SAVING

The new advanced design pumps represent a 100% increase in power-to-weight ratio over any other variable displacement pumps now available. The magnitude of this improvement is evident from the fact that every added pound of component increases a missile's gross weight from 30 to 75 pounds.

IMPROVED RELIABILITY

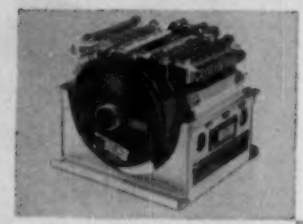
Exceptional capabilities (high speed, long life and contamination tolerance) under extreme conditions . . . even greater under normal application.

PARTS STANDARDIZATION

Major parts are interchangeable for fixed and variable displacement pumps and for fixed and variable motors in each series. This standardization results in customer savings.

†PATENTS PENDING

THREE NEW MINIATURES ADDED TO BENDIX GYRO TRANSMITTER FAMILY

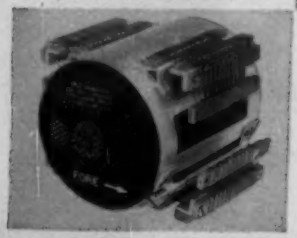


VERTICAL GYRO TRANSMITTERS

3¾" x 5" without mount
... ¼° vertical accuracy

FREE GYRO TRANSMITTERS

4" x 5" . . . drift less than ¼° per minute on either axis



DIRECTIONAL GYRO TRANSMITTERS

3¾" x 4½" without mount... 6° drift per hour max.

SOME ADVANTAGES TO YOU

★ Integral mount with torsion cable suspension on Directional and Vertical Gyro Transmitters protects against shock and vibration.

★ Gyros are completely self-contained, requiring no erection amplifier.

★ Our mass production facilities make gyros available to you at volume prices and on fast delivery schedules.

★ If our standard units don't match your needs exactly, we will design special gyros that will—and still give you the benefit of mass production without sacrifice of quality.

Eclipse-Pioneer Division

Teterboro, N. J.

District Offices: Burbank and San Francisco, Calif.; Seattle, Wash.; Dayton, Ohio; and Washington, D. C. Export Sales & Service: Bendix International Division, 205 E. 42nd St., New York 17, N. Y.

Bendix AVIATION CORPORATION

PRIVATE LINES

Credit service for private and business pilots, developed by American Express Co., permits charging aviation gas, oil, parts, maintenance, plane charter and other services. First aircraft service operation to join the credit card plan was Newark (N. J.) Air Service. New service now is part of comprehensive Amex credit card providing hotel accommodations charges, as well as meals, entertainment, car rental, telegrams and other features.

Largest single government-sponsored airborne magnetic survey ever carried out in Canada has been awarded Spartan Air Services, Ltd., Ottawa, by Province of Ontario's Department of Mines. The $400,000 survey will cover some 60,000 sq. mi. of Northern Ontario and Spartan will use two Cessna 310 aircraft for the job. Planes will carry a new Varian nuclear precession type magnetometer, which records data on punched tape and graph paper.

Kellett Cropduster autogiro has received Federal Aviation Agency Type Certificate. Aircraft followed original prewar Kellett design so closely that it was recertificated with same TC number, 712.

Mobile field X-ray inspection service, designed for use at any business or private aircraft operator's base, has been inaugurated by Lockheed Aircraft Service-New York International Airport. Unit provides non-destructive testing and inspection without need to disassemble airframe to get at otherwise inaccessible areas.

Private plane tour, sponsored by Philadelphia Junior Chamber of Commerce, will be held from Las Vagas, Nev., to Philadelphia Aug. 8-13. Single- and twin-engine aircraft are eligible. Entrance fee is $30. Contact Junior Chamber of Commerce at 121 South Broad St., Phila. 7, Pa.

Airplane Financing

Wichita, Kan.—Financing of new airplanes for Cessna Aircraft Co. dealers will run at the rate of approximately $1 million monthly for this fiscal year, according to National Aero Finance Co., the manufacturer's wholly-owned subsidiary. Nafco probably will process approximately 1,000 aircraft on floor plans for the Cessna dealer organization in Fiscal 1959, accounting for some 30% of airplanes delivered to sales outlets. Last year the finance company handled approximately 900 airplanes.

Aerial Photo Duplicated by Xerography

Aerial reconnaissance print, utilizing a xerographic duplicating process, can be finished 22 sec. after exposure of an aerial photographic negative. Printer, developed by Haloid Xerox, Inc. under Air Force contract, produces 9 x 9 in. prints in 2½ sec. from aerial roll negatives. Actual prints have a sepia cast.

Navy Contracts

Following is a list of unclassified contracts of $25,000 and over as released by Navy Contracting Offices:

AVIATION SUPPLY OFFICE, 700 Robbins Avenue, Philadelphia 11, Pa.

The Goodyear Tire and Rubber Co., Akron, Ohio, wheel assemblies: nose, for A3D aircraft, N383-58763A(383/211243/59), 526 ea., $85,428.

Douglas Aircraft Co., Inc., El Segundo, Calif., services and materials: to restore to ready-for-issue condition to the latest Navy approved configuration, gyro controls, roll rate, N383-57930A(383/212271/59), $228,-303.

Plaikins, Inc., New York, helmets: flight deck crew sound attenuating, N383-58527A (IFB-383-585-59), 11,066 ea., 33,973.

Ganary Bros., Mt. Ephraim, N. J., tension bars; catapult holdback, for launching various aircraft, N383-57792A(JD-IFB-383-553-59), $171,759.

M. Steinthal & Co., Inc., New York, parachute assemblies: back type, N383-59008A (IFB-383-546-59), $70 ea., $133,997.

Rubbercraft Corp. of America, Inc., West Haven, Conn., life rafts; pneumatic, for aircraft use, N383-58105A(383/271047/59-383/271111/59), $142,565.

Pioneer Parachute Co., Inc., Manchester, N. H., parachute assemblies: back type, N383-59007A(IFB-383-546-59), 750 ea., $114,270.

Vickers, Inc., Detroit, Mich., repair kits: to support hydraulic pumps on various aircraft, N383-57658A(383/213220/59), $42,-644.

Hydraulic Research and Manufacturing Co., Burbank, Calif., valves: hydraulic, for various aircraft, N383-58755A(383/214315/59), $33,901.

Texas Instruments, Inc., Dallas, Tex., meter movements: to support sonar equipment, N383-58825A(383/233253-59), 305 ea., $83,875.

Flexco, Inc., Huntington Park, Calif., hoses: air duct for various aircraft, N383-57765A(383/217378-59), 3,180 ea., $27,459.

Barber-Colman Co., Rockford, Ill., controllers: cabin air temperature, for F4D-1 aircraft, N383-57766A(383/212182-59), $356,352.

Aviators Equipment Corp., Beacon, N. Y., life rafts; inflatable, one person capacity, N383(MIS)58502A(MIPR 09-603-09-5220-78), 20,721 ea., $1,126,394.

United States Rubber Co., Passaic, N. J., hose: rubber, aircraft, hydraulic, pneumatic, fuel and oil resistant, N383-58995A(IFB-383-565-59), $35,578.

B. F. Goodrich Industries Co. Division, B. F. Goodrich Co., Akron, Ohio, hose: rubber, aircraft, hydraulic, pneumatic, fuel and oil resistant, N383-58994A(IFB-383-565-59), 118,036 ft., $41,903.

The Lewis Engineering Co., Naugatuck, Conn., indicator: temperature, thermocouple, for various aircraft, N383-58930A(IFB-383-588-59), 1,286 ea., $48,417.

Government Contract Sales Division, Dow Chemical Co., Midland, Mich., dichloromethane: technical, for use in preparation of acrylic resin plastic cement, paint removers and safety solvents, N383-58970A(IFB-383-536-59), $62,810.

Green River Steel Corp. Owensboro Ky. steel bars: chrome-molybdenum normalized round N383-58984A(IFB-383-544-59), 362,-226 lb., $50,645.

Parker Aircraft Co., Los Angeles, Calif., valves: main, to support hydraulic systems for various aircraft, N383-56323A(383/214190/59), $84,820.

P.S. and don't forget these other quality products at the

BENDIX "SUPERMARKET"

With our greater variety and greater volume of the precision components listed below, we have become the "supermarket" of the industry. We feature fast delivery and mass-production economy—plus the highest precision quality.

400-CYCLE SYNCHROS
(Frame sizes: 8, 10, 11, 15, 22)
Control Transformers • Differentials • Receivers • Resolvers • Transmitters

GYROS
Rate and Roll Gyro Transmitters • Stable Platforms

MOTORS AND GENERATORS
Gear Head Motors and Motor Generators • Low-Inertia Servo Motors • Motor Generators • Precision Induction Tachometer Generators • Rate Generators

PACKAGED COMPONENTS
Analog-Digital Converters • Azimuth Counters • Cam Compensators • Clutched Synchros • Dual-Speed Synchros • External Slip-Ring Synchros • Follow-Up Mechanisms • Miniature Differential Gear Assemblies • Servo Assemblies

RADAR DEVICES
Airborne Radar Antennae • Ground Antenna Pedestals

YCBTBS
You Can't Beat The Bendix "Supermarket". Try us.

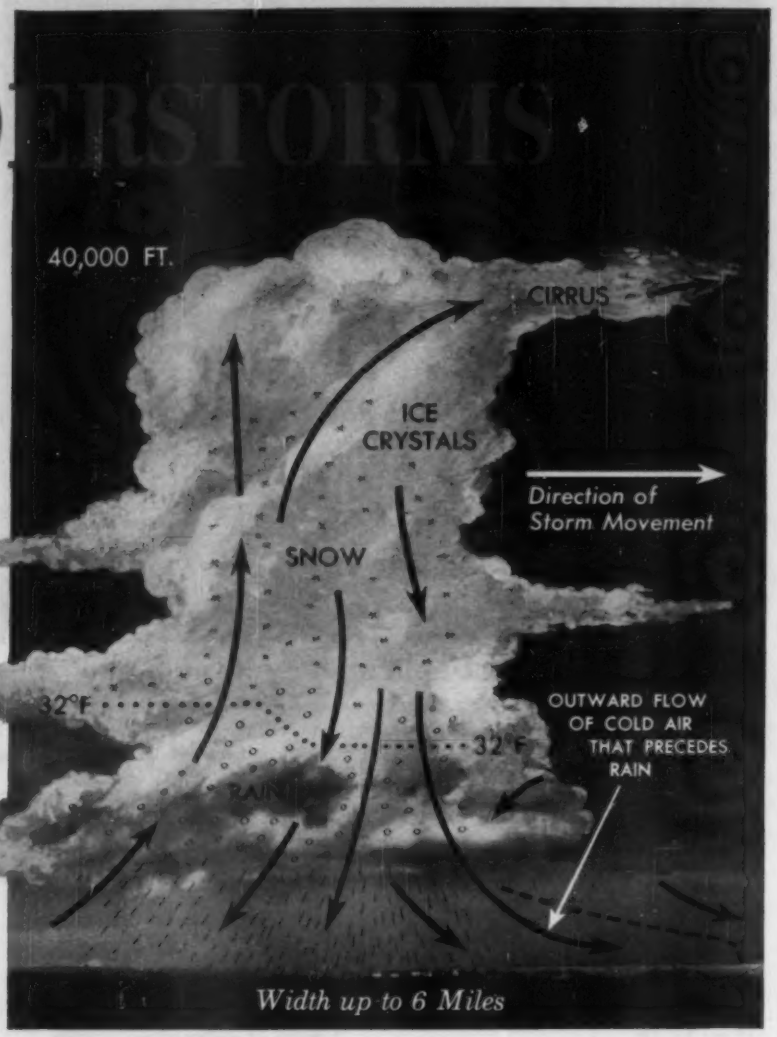
Eclipse-Pioneer Division
Bendix
AVIATION CORPORATION
Teterboro, N. J.

FLY WEATHER-WISE

Mobil

These weather items prepared in consultation with the United States Weather Bureau

THUNDERSTORMS



SINCE most flyers avoid thunderstorms either visually or with radar, the only time they usually have to be reckoned with is near airport during take-offs or landings. Diagram at right indicates hazardous features of a mature thunderstorm.

Notice the wedge of rain-cooled air that pushes along the ground ahead of the storm. It is this rush of air that creates the greatest hazard to planes maneuvering in the vicinity. Very sudden wind-shifts may destroy lift momentarily and sudden drop in temperature can adversely affect engine performance. Cold downdrafts precede and accompany heavy rain and are usually followed by updrafts in rear portion of storm.

Maximum turbulence occurs in region of heavy rain where downdraft is closest to updraft. It is encountered between 12,000 and 20,000 ft. Maximum hail occurs between 10,000 and 15,000 ft., sometimes in clear air just outside cloud.

If forced to fly through storm, take following precautions: Prepare engine, de-icing equipment and instruments for changing conditions. Avoid turns and other maneuvers after penetration. Avoid over-controlling, ride with the drafts. Slow down to safe speed, but don't lower flaps to accomplish this. Don't try to adjust throttle for every change in airspeed indicator which is affected by brief pressure changes and rain.

FORECAST:

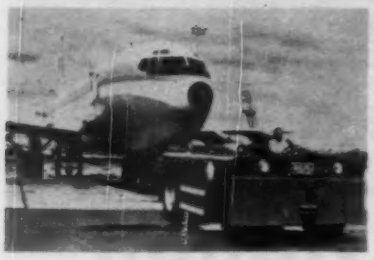
Top Flight Performance with Mobilgas Aircraft and Mobiloil Aero!

For top power . . . unsurpassed protection, rely on Mobilgas Aircraft and Mobiloil Aero. This famous fuel and quality lubricant have been designed to assure immediate throttle response and dependable performance under all weather conditions. Fly safely! Fly with Mobil!

Mobil

Tune in "TRACKDOWN" every week. CBS-TV. See your local paper for time and station.

NEW AVIATION PRODUCTS

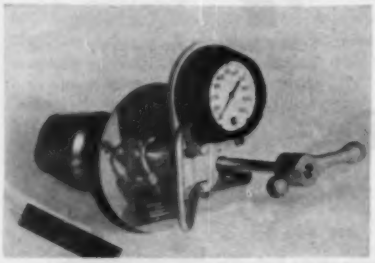


Transport Tow Tractor

Jet transport tow tractor is capable of traveling with a load at speeds of 26 mph.

Tractor, powered by a Chrysler 260-hp. industrial engine, has a 30,000 lb. drawbar pull. A drawbar hitch at either end of the vehicle permits towing in either forward or reverse gear.

Silent Hoist & Crane Co., 63rd St., Brooklyn 20, N. Y.



Reception Coupling Tester

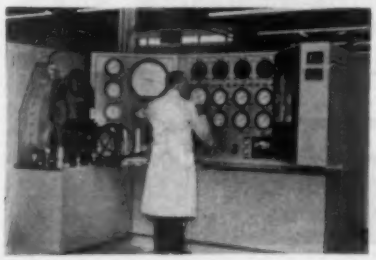
Coupling tester is used for ground checking of engaging and disengaging forces between aerial refueling equipment.

Aluminum MA-2 pull-off tester is manually inserted into the tanker aircraft's reception coupling to check the toggle tension and pull-off load forces. Forces are recorded on a closed hydraulic circuit.

Flight Refueling Inc., Friendship International Airport, Baltimore, Md.

Jet Accessories Tester

Major accessories test stand, designed for jet transport operators, tests fuel controls, fuel pumps, pressurization and dump valves and other subassemblies of Pratt & Whitney JT3 and JT4 engines.



Model 8893 test stand uses a high pressure variable speed pump to schedule fuel flow to the fuel control inlet. Variable speed drive holds speed within ½% of set speed with a load change of 0 to 100% over a speed range of 500 to 4,000 rpm. Flowmeter ranges are 215 to 36,000 pph. or −½% for metered flow and for low return flow, 19 to 3,120 pph. plus or minus 1%. Vacuum pump to simulate high altitude is capable of maintaining 29 in. of mercury vacuum continuously.

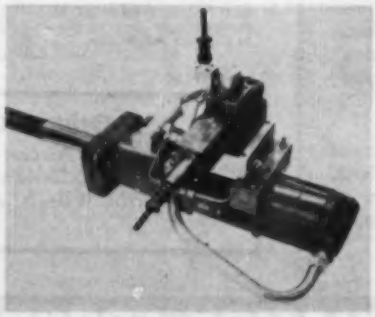
George L. Nankervis Co., 15400 Fullerton Ave., Detroit 27, Mich.

Freon Service Cart

Service cart is intended for line and overhaul servicing of Freon refrigeration systems of commercial jet transports.

The cart will recharge both Freon and lubricating oil and evacuate the Freon system to 100 microns or less. Dehydration and filtration of Freon and lubricating oil is achieved with a dessicant and 2-5 micron filters. Available as an option is a leak detector. The cart can be modified to meet customer requirements.

Kahn and Co., Inc., 541-549 Windsor St., Hartford 1, Conn.



Electro-Hydraulic Actuator

Actuators are designed for accurate positioning of rocket nozzles, aircraft guidance simulators, wind tunnel models and deflecting walls. Positioning systems are capable of 8 fps. speeds on a 4-in. cylinder with accuracy better than 1 part in 2,000.

Positioners are available in a range of from 1 to 500 hp. and operate at pressures to 3,000 psi. Frequency response is flat up to 19 cps. in large capacity systems, and up to 50 cps. in smaller systems.

CompuDyne Corp., 451 S. Warminster Rd., Hatboro, Pa.

Missile Rate Gyros

Miniature fluid-filled rate gyros are designed for flight control systems of both aircraft and missiles.

Gyros, operating in a temperature range of from −65 to +185F, are single-degree-of-freedom, viscous damped, spring restrained (torsion bar) types. The maker says that the use of compensatory damping mechanisms obviates the need for accessory heaters thus reducing weight and volume. Units having weights from 45 to 1,000 deg. per second, are available.

Kearfott Co., Inc., 1500 Main St., Clifton, N. J.

Ultrasonic Vapor Degreaser

Degreaser, designed for the Air Force, cleans aircraft engine and instrument components including oil and fuel strainers, pistons and rings, valves, bearings and pumps.

Components are placed first in a boiling solvent, then in an ultrasonic cleaning tank, flushed with a solvent spray and left in the vapor which dissolves any trace of grease or carbon. The maker says that the unit requires 1/40 the time of manual cleaning methods.

Narda Ultrasonics Corp., Westbury, N. Y.

Pressure Transducers

Pressure transducers intended for jet and rocket engine testing are designed to resist effects of corrosive liquids and gases.

Model GP-15D is a miniaturized

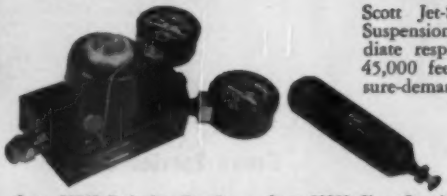
Scott OXYGEN EQUIPMENT for Civil Aviation

STANDARD EQUIPMENT ON MOST OF THE JET AIRCRAFT AND MAJOR AIRLINERS

Scott Emergency Oxygen System. Automatically dispenses oxygen masks to passengers from overhead cabin service pods in event of a sudden decompression or cabin pressure loss.

Scott 10500 Automatic Turn-On Valve. Activates emergency passenger oxygen system in event of cabin pressure loss.

Scott Jet-Set Fast-Donning Mask Suspension Device. Provides immediate respiratory protection up to 45,000 feet with demand or pressure-demand oxygen equipment.



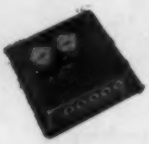
Scott 10260 Reducing Regulator. Reduces cylinder pressure to system working line pressures. Highest capacity. Lightest weight.

Scott 10850 Slow Opening Cylinder Valve. Extra safety protection against high pressure surge when turned on.

Scottoramic Mask with vision unlimited. Gives visual and respiratory protection to crew during smoke and fume emergencies.

Scott 5600 Portable Dual-Purpose Oxygen Unit. Provides demand and constant flow oxygen. Serves passengers and crew for supplemental, therapeutic, or smoke protection use.

Scott Aviox. Portable oxygen equipment for four, complete in a quality leather case.



Scott Oxygen Console. Fixed type. Supplies oxygen to from 1 to 5 persons.

Scott "President" Oxygen Installation Kit. Complete equipment for 1 to 5 persons.

Scott 10400 Diluter-Demand Miniature Panel Regulator. Supplies all crew oxygen requirements for jet transport operation.

Other SCOTT Products

- Light Aircraft Tailwheel Assemblies
- Brake Cylinders • Parking Brake Valves
- Control Wheels • Air Temperature Gauges

SINCE 1932 Scott FOR SAFETY · FOR SERVICE

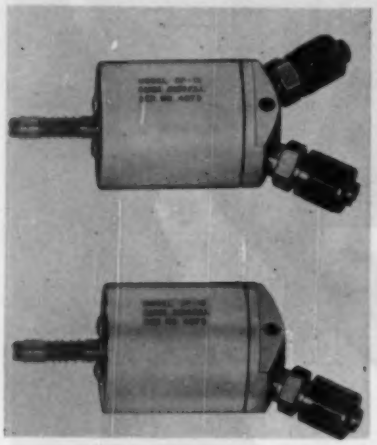
SCOTT AVIATION CORPORATION

8358 ERIE STREET • LANCASTER, NEW YORK

Export: Southern Oxygen Co., 250 West 57th Street, New York 19, N. Y.

West Coast Office: Fulton-Ventura Building, 13273 Ventura Boulevard, Studio City, California

unit said to be resistant to mechanical shock and vibration. It is available in ranges from 10 to 6,000 psig. Model DP-15D, a differential pressure transducer incorporating dual bleed screws,



is available in ranges from + or − 5 to + or − 5,000 psi. differential at line pressures to 5,000 psi. Both units are constructed of type 416 stainless steel to achieve high strength and resistance to the corrosive liquids and gases associated with rocket testing.

BJ Electronics, Borg-Warner Corp., 3300 Newport Blvd., Santa Ana, Calif.

Synchro Instrument Tester

Test kit is designed for field testing of aircraft synchro-transmitter/indicator systems. Kit is intended primarily for operaters of jet transport aircraft.

Model TE-2A synchro test standard combines four instruments: an a. c. voltmeter for checking aircraft voltage, a master indicator for checking syn-

chro-transmitters, a master transmitter for checking synchro-indicators and a transformer for checking electrical zero of synchro-indicators. Test unit weighs 10 lb., is contained in an aluminum case measuring 8 x 9 x 16 in.

U. S. Gauge, division of American Machine and Metals, Inc., Sellersville, Pa.

WHAT'S NEW

Telling the Market

Description of a **packaged light source for recording high-speed phenomena** with shadowgraph and schlieren systems, bulletin, Marketing Department, M-3, Research and Advanced Development Division, Avco Manufacturing Corp., 201 Lowell St., Wilmington, Mass. . . . Flow-rate pressure drop curves, cross-section drawings and installation drawing of No. 565383 **replacement elements for aircraft main fuel line filters,** engineering data sheet No. 102, Bendix Filter Division, Bendix Aviation Corp., 434 West 12 Mile Rd., Madison Hgts., Mich.

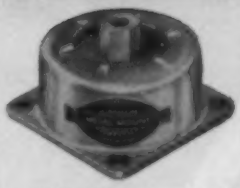
Illustrated description of **polyvinyl-insulated, multi-conductor cable** for installing six to 56 pairs of thermocouple loads at one time, Catalog 33, Thermo Electric Co., Inc., Saddle Brook, N. J. . . . Electrical and mechanical characteristics and drawings of all types of **synchros and rotary components,** catalog, Clifton Precision Products Co., Inc., 9014 West Chester Pike, Upper Darby, Pa.

No. 1 and 2 of a series of new literature on **ideas for die protection,** Micro Switch, a division of Minneapolis-Honeywell Regulator Co., Freeport, Ill. . . . Uses and descriptions of precision, pressure-sensitive **tapes and symbols for master drawings in printed circuitry,** folder, Chart-Pak, Inc., One River Rd., Leeds, Mass. . . . Method of operation, dimensions, materials of construction, and optional features of **Deltadyne differential pressure indicator,** Bulletin A-109, Aircraft Porous Media, Inc., 30 Sea Cliff Ave., Glen Cove, N. Y.

Specifications, performance data, application information and optional features of **solenoid valves,** Catalog 444, Atkomatic Valve Co., 545 West Abbott St., Indianapolis, Ind. . . . Presentation of **engineering facilities** for the design and manufacture of automatic wide-band countermeasures, special equipment and complete systems, brochure, Instruments for Industry, Inc., 101 New South Rd., Hicksville, N. Y. . . . **A Guide to Fire Extinguishers,** folder, Fire Equipment Division, Ansul Chemical Co., Marinette, Wisc.

Application, engineering data, performance curves and dimension drawings of **accessory equipment for aircraft, missile and spacecraft,** catalog, Lyndon Aircraft, Inc., 140-16 Clifford St., Newark 5, N. J. . . . Re-Usable Steel and Aluminum **Shipping Containers** for parts and components of electronics, air-

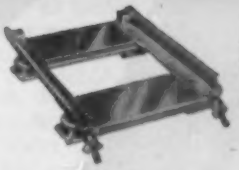
JOHNSON



Standard All-Metal Mounts

Johnson offers a complete line of Standard All-Metal Mounts, approved by the military for aircraft and missiles and interchangeable with other mounts and isolators.

JOHNSON



All-Metal Mounting Bases

Johnson's ruggedized aluminum bases withstand 15G and 30G shock conditions . . . fit standard and non-standard shapes . . . conform to Mil-C-172B.

JOHNSON

All-Metal Stabilizers

Johnson manufactures the only true horizontal stabilizers available. Free-sliding, they are designed to work in perfect coordination with vertical mounts.

JOHNSON

Specially Engineered Mounts

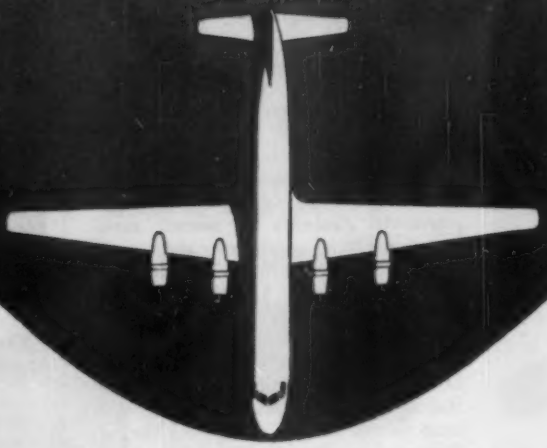
Johnson engineers . . . fully qualified . . . are always ready to help you on specially-engineered mounts and bases. Contact our engineering department.

Quality Products Through YEARS OF PROVED PERFORMANCE

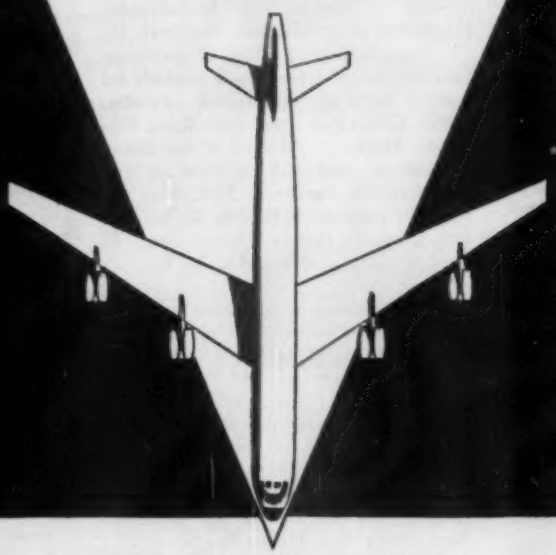
SEND FOR COMPLETE INFORMATION IN CATALOG NO. 3

K. W. JOHNSON & COMPANY, INC.
1825 Webster Street, Dayton 4, Ohio
BAldwin 4-1078

Sinclair
supplies 45% of the aircraft oil used by
major scheduled airlines in the U.S.

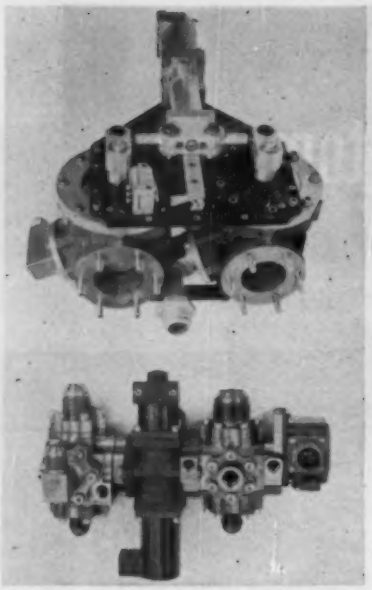


Sinclair
aircraft oil is also used to
lubricate the mighty engines of
commercial and military jets



You can depend on
Sinclair
Aircraft Oils

Sinclair Refining Company, Aviation Sales, 600 Fifth Avenue, New York 20, N. Y.



X-15 Propellant Valves

Valves for the liquid fueled engine of the North American X-15 hypersonic research aircraft include the main propellant valve (top) and intermediate stage dual propellant valve. Ball valves meter liquid oxygen and ammonia to the Reaction Motors engine at rates of 10,000 lb./min. Flo-Ball valves are produced and manufactured by Hydromatics, Inc., Livingston, N. J.

---

craft, atomic equipment, missiles and rockets, illustrated brochure, DeVilbiss Metal Fabricators Co., 5741 Russell St., Detroit 11, Mich.

Technical description of **miniature magnetic tape recorders for airborne applications,** five instrumentation bulletins, BJ Electronics, Borg-Warner Corp., 3300 Newport Blvd., Santa Ana, Calif. . . . Applications and specifications of Model 502 **AC-DC digital voltmeter,** Data Sheet No. 19-41, Kin Tel, Cohu Electronics, Box 623, San Diego, Calif. . . . Selection charts, graphs, and mechanical and electrical properties of **AlSiMag ceramics,** Chart No. 591, American Lava Corp., Manufacturers Rd., Chattanooga 5, Tenn.

Applications, functions, specifications and operating characteristics of **valves, strainers, filters, etc., for aircraft and missiles,** catalog, Koehler Aircraft Products Co., 409 Leo St., Dayton, Ohio. . . . Illustrated description of **commercial jet engine test stands** and other test equipment, Catalog No. 1383, George L. Nankervis Co., 15400 Fullerton Ave., Detroit 27, Mich.

Photographs, block diagrams, outline drawings, and specifications of Model 2HLA-4a **D-C amplifier with isolated differential input,** Catalog B-C2HLA-4, Minneapolis-Honeywell, Boston Division, 40 Life St., Boston 35, Mass. . . . Key information on **linear motion potentiometers, pressure transducers, accelerometers and angular position transducers,** Instrument Summary Brochure —March, 1959, Bourns Laboratories, Inc., P. O. Box 2112, Riverside, Calif. . . . **Gaseous Oxygen Laboratory Tests Critical Missile Equipment,** illustrated brochure, A. L. Spangenberg, Director of Engineering Laboratories, Whittaker Controls Division of Telecomputing Corp., 915 North Citrus Ave., Los Angeles 38, Calif.

Publications Received:

Van Nostrand's Dictionary of Guided Missiles and Space Flight—by Grayson Merrill, Capt., USN (ret.)—D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N. J. $17.50; 688 pp. Dictionary defines and explains most commonly used terms in the guided missile and space flight field today.

Magnetic Amplifier Engineering—by George M. Attura—McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. $7.50; 220 pp. A basic guidance on magnetic amplifiers.

Civil Test Planned Of Runway Barrier

New York—First civil aviation evaluation of runway arresting barriers begins this month at the Federal Aviation Agency's National Aviation Facilities Experimental Center, Pomona, N. J.

The six-month program, to be conducted by All American Engineering Co. under a $125,000 FAA contract, will test the effectiveness of the company's runway barriers in engaging the main landing gear of jet transport aircraft.

A truck-powered full-scale mockup of a jet transport landing gear, including stub wings and landing gear pods, will engage the barriers at speeds to 60 mph.

Two types of runway barrier will undergo test. The first barrier, All American's Model 56, utilizes a trigger cable which, when engaged by the nosewheel, raises the 1¼-in.-diameter arresting cable above the tires to snag the main landing gear struts.

The second barrier to be tested will utilize a pneumatic system to raise the arresting pendant.

In other tests, an Air Force Convair C-131 transport will be fitted with a belly hook for tests of the arresting engine itself.

WCA

West Coast sets new passenger records with F-27!

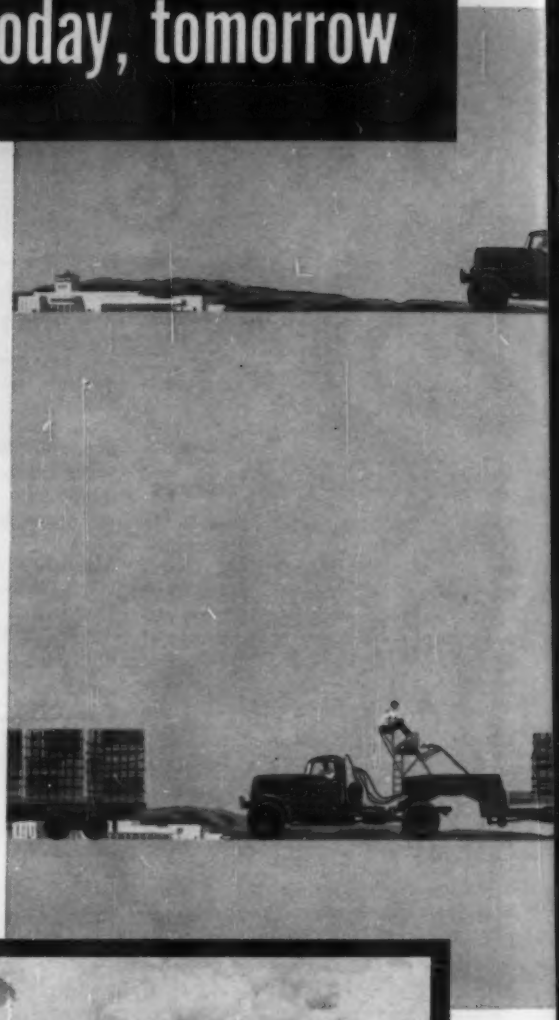
Since the F-27 Prop-Jet was introduced six months ago:

- The average passenger load is up 48% on flights where F-27's replaced DC-3's.
- System-wide there is an increase in passengers per mile of 19.81%.
- Total passengers carried has risen 14.62%.
- The average distance per passenger increased from 180 miles to 194.
- The volume of interline exchange broke all records for a six-month period.

WEST COAST AIRLINES

Serving 42 cities in Washington, Oregon and Idaho; soon to serve 21 more in California, Utah and Montana.

Lockheed's HERCULES Airfreighters –
Your profit-partners: today, tomorrow

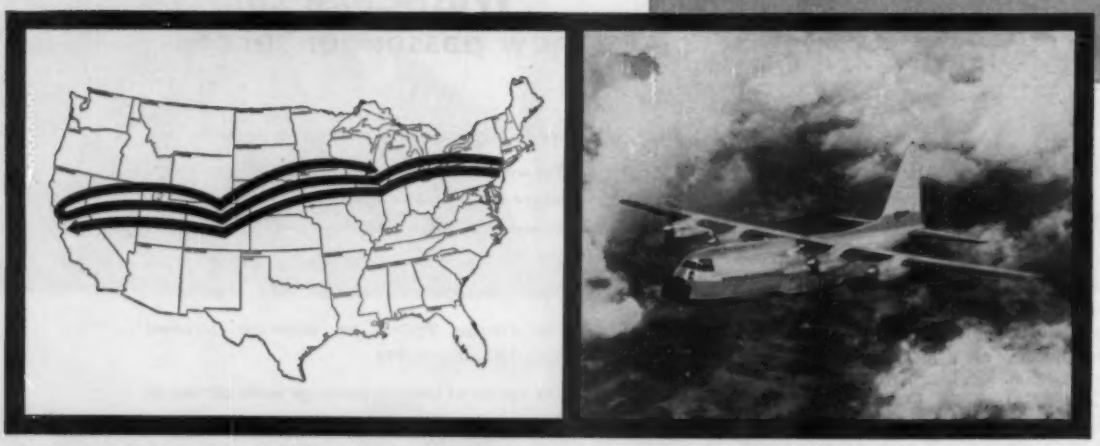


Designed to haul the goods of the world in the Jet Age, the Lockheed HERCULES Airfreighter has a profit-making edge over any other cargo hauling aircraft now flying.

One important advantage is the Lockheed-developed Lightning Loader system. With it you can winch 22 tons of palletized cargo in or out of a HERCULES Airfreighter in only 40 seconds!—saving hours of ground time.

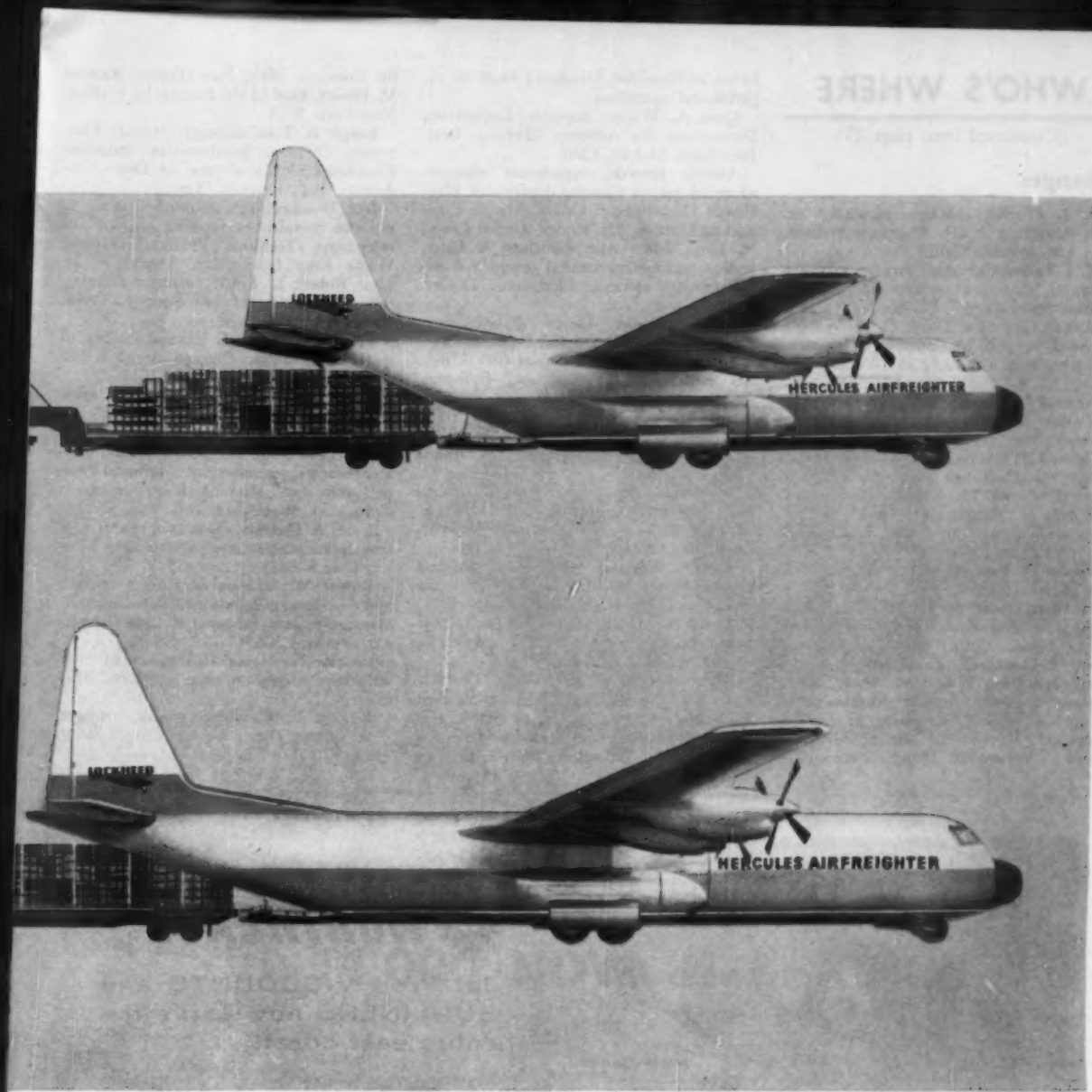
Looking ahead to the time when air cargo volume demands more payload capability, Lockheed again has the answer—the bigger, longer-ranged SUPER-HERCULES Airfreighter, which can bring direct operating costs down below 4 cents per ton mile. And pay you a handsome profit doing it.

To compete for air cargo profits today, the HERCULES is your best buy. Then, when your volume warrants it for your heavy volume, long range routes, add the new SUPER-HERCULES Airfreighters—retaining the HERCULES on other routes to give you a completely integrated operation.



Map compares cross-country flights of Prop-Jet HERCULES Airfreighter, using Lightning Loader system, and fastest type piston-engine cargo transport. Both leave New York with identical 20-ton cargoes, make same en route stops, unload and reload identical cargo at each stop. By the time piston-engine plane arrives in San Francisco the Lockheed HERCULES Airfreighter has reached Chicago on return trip.

Over-the-weather capability of the HERCULES Airfreighter is an important profit-making plus. "On time" deliveries of air cargo keep today's customers happy, build air freight volume and profits for the future.



TOP ILLUSTRATION: **Today's HERCULES Airfreighter,** using Lockheed's Lightning Loader system, can land, unload entire 6-pallet, 22-ton payload, reload, and take off—in less than 20 minutes time!

BOTTOM ILLUSTRATION: **Tomorrow's SUPER-HERCULES** Airfreighter has 23-foot longer fuselage, greater wingspan, maximum 10-pallet, 39-ton payload capability—plus same Lightning Loader system.

LOCKHEED

JET TRANSPORTS • JET FIGHTERS • JET TRAINERS • COMMERCIAL & MILITARY PROP-JET TRANSPORTS • ROCKETRY
BALLISTIC MISSILE RESEARCH & DEVELOPMENT • WEAPON SYSTEM MANAGEMENT • ANTI-SUBMARINE PATROL AIRCRAFT
NUCLEAR-POWERED FLIGHT • ADVANCED ELECTRONICS • AIRBORNE EARLY-WARNING AIRCRAFT • AIRPORT MANAGEMENT
NUCLEAR REACTOR DESIGN & DEVELOPMENT • GROUND SUPPORT EQUIPMENT • WORLD-WIDE AIRCRAFT MAINTENANCE

WHO'S WHERE

(*Continued from page 23*)

Changes

R. J. Pfeiffer, manager-commercial aircraft marketing, North American Aviation, Inc., Los Angeles, Calif.

T. J. Sullivan, assistant division manager-contracts, customer service and material, Convair (San Diego) Division of General Dynamics Corp., San Diego, Calif. **William T. Alvis** succeeds Mr. Sullivan as manager of contracts at Convair's Ft. Worth, Tex., plant.

Edward N. Skomal, solid state marketing specialist, Motorola Electronics Division, Phoenix, Ariz.

Derek J. Whitehead succeeds **Tim Wood,** retiring, as chief test pilot, Blackburn & General Aircraft, Lt., East Yorks, England.

Robert O. Briggs, chief engineer, Electronics Division, United ElectroDynamics, Inc., Pasadena, Calif.

Edwin D. Eaton, manager of the newly created specialized ground support equipment department of Hamilton Standard, division of United Aircraft Corp., Windsor Locks, Conn. Other appointments: **Raymond P. Lambeck,** chief of preliminary design and sales; **Wilson M. Alford,** development engineer; **Harold Rourke,** chief of ground support equipment production; **Sherwood V. Martin,** administrative assistant. **Vernon E. Hupp** succeeds Mr. Eaton as Hamilton Standard's chief of experimental operations.

Louis A. Wayne, manager, Engineering Division of the Astronics Division, Lear, Inc., Santa Monica, Calif.

Anatole Browde, department manager-advanced systems planning department, Electronics Departmental Group, Missile Engineering Division, McDonnell Aircraft Corp., St. Louis, Mo. Also: **Matthew A. Lafer,** section manager-mechanical design and developmental services, Electronics Departmental Group.

Michael Dodak, director of marketing, Arnoux Corp., Los Angeles, Calif.

Hughes Aircraft Co., Culver City, Calif., has established Far East and European offices, and made the following appointments: **Edwin P. Ramsey,** in charge of Far East Operations, Tokyo, Japan; **George E. Todd,** in charge of European Operations, Paris, France.

Northrop Corp., Beverly Hills, Calif., has established a corporate district office at San Antonio, Tex., and appointed **Arvid E. Olson, Jr.,** manager.

Edward Waldman, general manager, and **George Brown, Sr.,** chief engineer, Telectro Industries Corp., Long Island City, N. Y.

David D. Munro, III, manager, electrical and electronic laboratories, Commonwealth Engineering Co., Dayton, Ohio.

Thompson Ramo Wooldridge Products Co., Los Angeles, Calif., has established European and Eastern United States sales engineering offices, and made the following appointments: **Willard A. Bridges,** head of the European office, Paris, France; **Richard M. Hexter,** head of the Eastern U. S. office, New York, N. Y.

Joseph B. Tate, manager, Military Electronics Division, Southwestern Industrial Electronics Co., a division of Dresser Industries, Inc., Houston, Tex.

Jack Winslow, administrative assistant to the vice president-engineering program development, Technical Products Division, Waste King Corp., Los Angeles, Calif. Also: **Robert L. Potter,** manager-manufacturing services department; **James L. Lecka,** technical representative.

Frank R. Demchock, assistant director of customer relations, Chicago Aerial Industries, Melrose Park, Ill.

Otis F. Bryan, manager of airline sales, Link Aviation, Inc., Binghamton, N. Y.

William P. Novack, supervisor-manufacturing engineering, and **Carlyle Moore,** manager-technical reproductions, Technical Products Division, Packard Bell Electronics Corp., Los Angeles, Calif.

James A. Doherty, director of quality control, Summers Gyroscope Co., Santa Monica, Calif.

Robert W. Landee, director of research and development for airborne data communication, Western Division of Collins Radio Co., Burbank, Calif.

Charles N. Hood, II, director of engineering, Airborne Accessories Corp., Hillside, N. J.

Edward N. Gomberg, general manager, Consolidated Diesel Electric Corp.'s Western facility, Los Angeles, Calif.

NORTHEAST

Jet-Prop VISCOUNTS and SUNLINERS now serve the entire east coast!

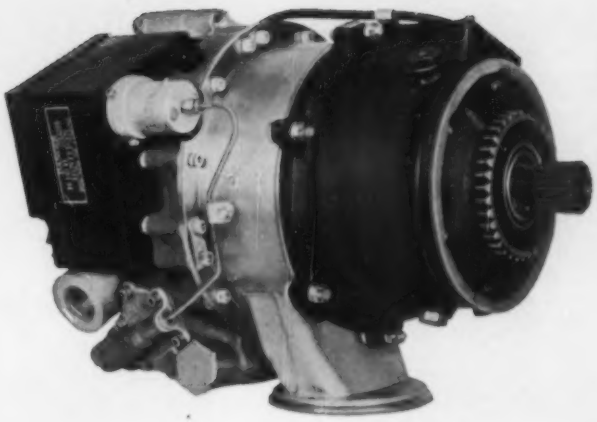
Montreal	New York	Jacksonville
Portland	Philadelphia	Miami
Boston	Washington	Tampa

During the past year, passenger preference for Northeast Jet-Prop Viscount and Sunliner Service has made Northeast one of the nation's fastest growing airlines. And every day more and more people are choosing Northeast for the finest in air travel between Montreal and Miami.

NORTHEAST AIRLINES

26 years of progressive air service

The FAS 500-1 fuel-air jet engine starter makes Convair's F-106 fighter-interceptor ready for emergency scrambles. In as little as 12 seconds, this 48-pound, 165 hp. unit can bring the mighty J-75 engine compressor to 2600 RPM for starting, and sustain 3000 RPM several seconds more for acceleration and safety.



Jet Engine Starters . . . by Hamilton Standard

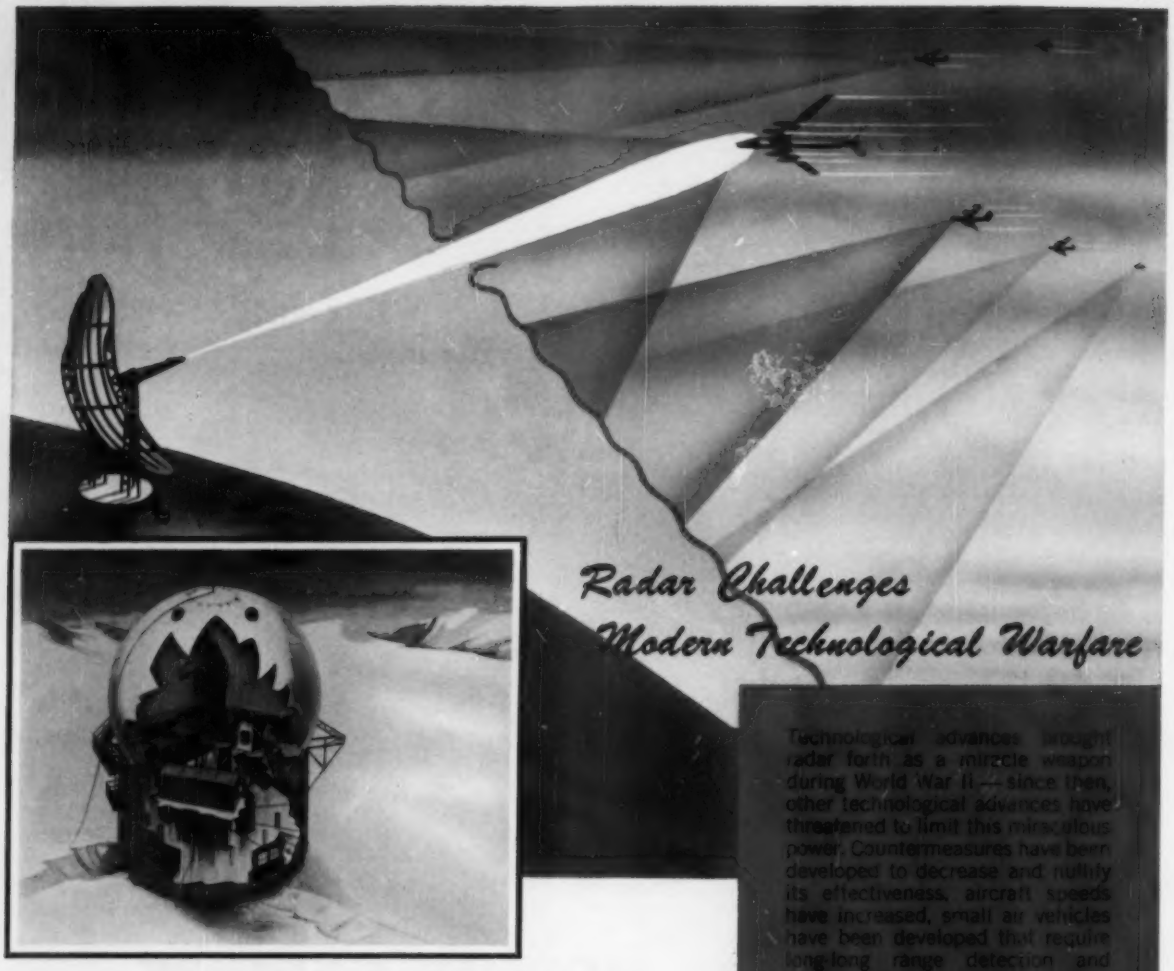
14,000 NOW IN SERVICE

HERE IS AN OUTSTANDING ACHIEVEMENT where tough performance requirements are attained with unexcelled dependability and reliability. It is one of 14,000 jet engine starters built by Hamilton Standard in the past 10 years for 26 different types of first line aircraft and missiles. Twenty basic pneumatic and fuel-air models produced typify Hamilton Standard's 40 years of leadership in meeting ever-new challenges in the fast changing world of flight. These and other exciting products and projects are clear evidence that Hamilton Standard will continue to lead in the future.

HAMILTON STANDARD

Windsor Locks, Connecticut

ENGINE CONTROLS • FLIGHT CONTROLS • PROPELLERS
STARTERS • ENVIRONMENTAL CONTROL SYSTEMS
VALVES • PUMPS



Radar Challenges Modern Technological Warfare

Technological advances brought radar forth as a miracle weapon during World War II—since then, other technological advances have threatened to limit this miraculous power. Countermeasures have been developed to decrease and nullify its effectiveness, aircraft speeds have increased, small air vehicles have been developed that require long-long range detection and tracking. Radar techniques must be developed to meet and counteract the technological advances.

AVCO/Crosley Radar Engineering is answering this challenge with new radars designed for longer range, greater accuracy, faster data handling, and greater operational capability in adverse environments.

An outstanding contribution of AVCO/Crosley radar engineering, the currently operational AN/MPS-16 Height Finder Radar, is being followed by other Crosley equipments of greater stature, including the AN/FPS-26.

The challenges of tomorrow must be anticipated and coped with today—you can be sure that AVCO/Crosley engineering is working hard to get timely answers.

Creative-Thinking Engineers Needed To Design and Develop Radar Systems

Crosley's heavy surveillance radar program covers all aspects —from the original advanced concepts to the production of equipment.

Crosley has interesting assignments in the fields of ECM, CCM, radar receivers, transmitters, indicators, micro-wave, plumbing, antennas, wave propagation, computers, primary power systems, and all aspects of radar equipment.

Mr. James T. Dale
Director, Scientific and Technical Personnel

Avco/Crosley

1329-L ARLINGTON STREET
CINCINNATI 25, OHIO

CAB Accident Investigation Report:

Pilot Error Blamed for Nantucket Crash

About 2334,[1] Aug. 15, 1958, Northeast Airlines Flight 258 crashed during an instrument approach to the Nantucket, Mass., Memorial Airport. The crew of three and 22 of 31 pasengers received fatal injuries. The nine surviving passengers were seriously injured. The aircraft, which burned after impact, was destroyed.

The accident occurred during a straight-in VOR (very high frequency omni range) instrument approach to runway 24 (240 deg.). An analysis of all the available evidence indicates that the approach was continued after receipt of a below-minimum visibility report.

At low altitude in the area of the "H" facility (a low-power nondirectional radio beacon), the flight encountered heavy fog in which the pilot lost orientation and ground reference. The aircraft contacted the ground almost simultaneously with the initiation of an attempt to discontinue the approach.

The accident investigation and public hearing by the Board, and an operational inspection of the company by the Civil Aeronautics Administration[2] (CAA), disclosed discrepancies which reflected adversely on some of the policies and procedures of the company and on the adequacy of the implementation of these policies and procedures. These criticisms are stated in the body of this report.

Through communications with company officials and the Administrator, the Board has been informed that positive steps have been taken by the company to eliminate the deficiencies and that rapid and substantial progress has been made.

The operational factors which were identified as deficiencies during this investigation were generally known and accepted by the local CAA agents prior to the accident. Recognizing that the responsibilities of the CAA were not fully discharged, the Administrator took action to correct the local situation at Boston. He also established an inspection process whereby closer supervision can be maintained over the effectiveness of all local CAA offices throughout the country.

INVESTIGATION

Northeast Airlines Flight 258 is a scheduled operation which originates at LaGuardia Airport, N. Y., and terminates at Martha's Vineyard, Mass., with one intermediate stop serving Nantucket, Mass. The flight is scheduled to originate at 2020 and arrive Nantucket and Martha's Vineyard at 2128 and 2210, respectively.

On Aug. 15, 1958, the flight crew assigned to the operation consisted of Capt. John T. Burnham, First Officer David C. Carey and Stewardess Arlene Dabek. Following routine preparations by the crew the flight departed LaGuardia at 2225 with 31 passengers, including one infant. Departure was about two hours late which was attributed to cumulative traffic and ramp delays encountered by earlier flights using the aircraft, Convair 240, N 90670.

Weather information pertinent to the route indicated that at departure visual flight rules (VFR) weather conditions existed but that by the time the flight reached Nantucket fog might necessitate an instrument approach. Accordingly, the flight departed VFR but on a dispatch release and flight plan which authorized instrument operation, if necessary; on this contingency Boston was designated the alternate airport.

At takeoff the gross weight of the aircraft was computed to be 38,478 lb., with the maximum allowable 40,800 lb. The load was properly distributed according to the center of gravity limitations of the aircraft. Computations also showed that upon reaching Nantucket the existing wind conditions and weight of the aircraft, 37,002 lb., permitted landing on the usable length, about 3,800 ft., of runway 24.

Flight 258 operated over Victor Airway 46 to Nantucket. Investigation showed that while en route the flight was in radio communication with the company radio located in the Nantucket terminal building and with Otis RAPCON (Radar Approach Control). The latter is manned by CAA personnel as an Air Traffic Control facility which has as part of its responsibility the control of instrument traffic for Nantucket. It is located at Otis AFB, Falmouth, Mass.

The radio communications between Northeast flights and the company radio are not electronically recorded although the essence of each is entered in a radio log by the ground communicator. The entry is made in the radio log when the communication is completed and at that time the actual time is noted and affixed to the entry. Operating the company radio and maintaining the radio log are among the duties of Northeast agent personnel and during the evening of Aug. 15 these duties were performed by the senior agent and one subordinate. On its face the log showed several errors and omissions and one time entry was changed, apparently to correct a mistake, although the original entry may not have been in error. Because of these discrepancies Board investigators found it mandatory to corroborate the evidence presented by the log before accepting it.

The radio transmissions between flights and Otis RAPCON are electronically recorded. Through "playback" and timing of the tapes it was possible to determine accurately the content of each radio transmission between Flight 258 and this facility as well as the time each communication occurred.

N 90670 was equipped with one VHF communications transmitter and one VHF communications receiver; therefore, Flight 258 could not communicate with Otis RAPCON and Nantucket company at the same time. This fact, and learning that the Northeast and Otis clocks were in accord, made it possible to compare the times of the Otis communications with the time entries in the radio log.

Because weather information given the flight was very important, comparisons were made between the recorded observations by the Weather Bureau and those recorded as having been furnished the flight. Further, the times of the observations were compared with the times they were passed to the flight.

During this work it was learned that the Weather Bureau clock was one minute faster than the Northeast and Otis timepieces. To avoid confusion this error has been eliminated in this report and the times indicated are corrected to the Northeast clock.

Analytical Comparison

Comparisons were made for analytical purposes using the times from the Otis tape, the Northeast log and the Weather Bureau log. In addition, the essence of the transmissions, the sequence of the transmissions, the testimony regarding the events, and the time involved in the VOR approach were all painstakingly compared to establish or refute the accuracy of the times entered in the radio log. The preponderance of this evidence sustains the accuracy of the time entries, especially the portion of the log kept by the senior agent beginning at 2328.

It was the testimony of a Northeast agent that the initial contact between Flight 258 and Northeast radio occurred about 2314 when the flight asked for the Nantucket weather.

He stated he transmitted the 2259 hourly sequence report which was: scattered clouds 500 ft., ceiling 12,000 ft., broken; visibility 4 mi.; fog.

The agent stated that at this time the senior agent took the microphone from him and in essence advised the flight that this weather report was obsolete and, according to a special report of 2311, the weather was "partial obscuration, three-fourths mile, fog." The agent stated that during this communication the flight also requested the strobe light[3] be turned on. Transmission of the special weather report was logged at 2311 and, although the information was acknowledged, according to the agent, this was not reflected by the radio log. The agent stated he requested the strobe lights be turned on by the CAA communicator who controlled the lights.

At 2314 the flight contacted Otis RAPCON and according to the recorded

[1] All times herein are Eastern Daylight based on the 24-hr. clock. Distances are nautical miles and altitudes are above the ground.

[2] The term CAA (Civil Aeronautics Administration) rather than FAA (Federal Aviation Agency) is used herein because this accident occurred prior to Dec. 31, 1958.

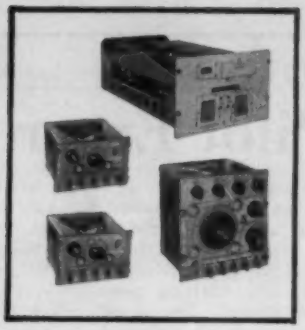
[3] Two condenser discharge flashing approach lights located in the approach zone 250 ft. from the threshold lights, one on each side of the runway edge extended.

COMMUNICATIONS...

Radio Set AN/ARC-57 . . . designed and developed by *The Magnavox Company*, in conjunction with the Air Force, is an essential UHF communications system, providing the utmost in performance and reliability for the CONVAIR B-58.

It clearly demonstrates *The Magnavox Company's* ability to produce and work as a prime contractor on a complex weapons system.

MAGNAVOX capabilities are in The Fields Of Airborne Radar, ASW, Communications, Navigation Equipments, Fusing and Data Handling . . . your inquiries are invited.



PRODUCTS
THAT SPEAK FOR
THEMSELVES

Magnavox

MAKES THE B-58 TALK!

COMMUNICATIONS | RADAR | DATA HANDLING | ASW | MISSILES

THE MAGNAVOX CO. • DEPT. 36 • *Government and Industrial Division* • FORT WAYNE, IND.

conversation advised Otis it was "visual" and past the Newport intersection (located 50 mi. southwest of Nantucket on Victor Airway 46) at 2312. The flight requested an instrument approach clearance to Nantucket estimating it would reach Nantucket at 2326.

The clearance was issued at 2315.

About 2324 Flight 258 advised Otis it was going to company frequency for "the altimeter, etc." The company radio log reflected that information as to the active runway, surface wind and altimeter setting was given the flight and logged at 2314. Investigation showed this time was entered following an erasure and that the time originally affixed was 2326. Because at approximately 2324 the flight stated it would request the information from the company it would seem the time entry of 2314 should have been 2326 as originally fixed. Further, because the CAA communicator who turned on the strobe lights testified it was done during the five-minute period preceding 2330, it is entirely probable that the request for lights occurred when the flight requested other landing information rather than during the previous communication. Certainly an inbound flight would request the lights and landing information more logically two or three minutes rather than 14 min. before an instrument approach.

From investigation and testimony obtained at the public hearing it was indicated that the senior Northeast agent did not know the current operating status of the strobe lights or, in particular, that one which had been inoperative was repaired earlier that day. Also, there was no defined procedure for informing ground personnel of the current airport field conditions. In fact, it was not clear to the working ground personnel how or by whom the day-to-day field inspection was made. Also, it was not clear how the working groups would learn of pertinent field conditions, and the procedure for passing such information between shifts was ill-defined.

The transmissions over the company radio were amplified; however, during periods of IFR conditions and when one flight was at the terminal a heavy workload would occur which could result in the radio being left unguarded. Similarly, weather information passed over the intercom could be missed and unknown to Northeast personnel until the Weather Bureau observer, according to procedure, brought it in typed form to the Northeast office.

It was the testimony of the senior Northeast agent that he gave Flight 258 a special weather report of "partial obscuration, one-half mile visibility, fog." This observation, according to the Weather Bureau observer and Weather Bureau log, was completed and logged at 2327 and immediately given Northeast over an intercom system. The senior agent stated he transmitted it to another Northeast flight, 2289, which was awaiting takeoff, and to Flight 258. The time affixed to the radio log entry was 2328. The log showed an acknowledgment from Flight 2289 but not from Flight 258.

The senior agent stated acknowledgment should have been recorded because he was very positive the information was received and associated it with a personal conversation between First Officer David Carey of Flight 258 and himself. This conversation

POWER — the 12 E carries and places 840 lb. power pole
THE NEW HILLER 12 E
(Undisputed performance leader for the toughest assignments of industry and commerce.)
THE HILLER OPERATOR
(Backed by the entire Hiller organization, he matches the 12 E's power and versatility with his skill and experience.)
TOP TEAM IN UTILITIES
(Survey — construction — line patrol — emergency repair vehicle — transporting men and equipment — many others.)
At the 10,000 foot level or sea level, midwinter and midsummer, the Hiller 12 E is the new aerial workhorse of America's utilities. And for good reasons! The 12 E saves days and dollars through vastly increased performance. Your Hiller operator, whose pilots have flown on almost every conceivable working assignment, is the exclusive supplier of the 12 E standard of helicopter service. For an illustrated brochure on the 12 E in action and information on Hiller Operators everywhere, write Dept.M, Commercial Division.
HILLER AIRCRAFT CORPORATION
PALO ALTO, CALIFORNIA · WASHINGTON, D.C.

was overheard by several persons near the radio room, the transmissions being normally amplified by the radio equipment. The senior agent testified that after giving the one-half mile visibility he said, "Did you get that half-mile, Dave?" First Officer Carey replied, "Roger, you know how I love Nantucket." The senior agent responded, "Don't plow up the field." The senior agent said this conversation was uncalled for and to him had no significance. He said that he recognized First Officer Carey's voice and added that Carey had worked on the Island for Northeast and they were personal friends.

Northeast Flight 2289 left the Nantucket terminal about 2321 and taxied to runup position beside runway 24. The captain recalled asking the company for the latest Martha's Vineyard weather. To this Flight 258 volunteered that Martha's Vineyard would be no problem and then asked, "How's it down there?" The holding flight replied, "Not too good." The captain testified that he recalled Flight 258 being given "partial obscuration, three-fourths mile" and that it was acknowledged. He stated that thereafter he recalled visibility reports from the company radio of one-half mile, one-fourth mile, and one-eighth mile.

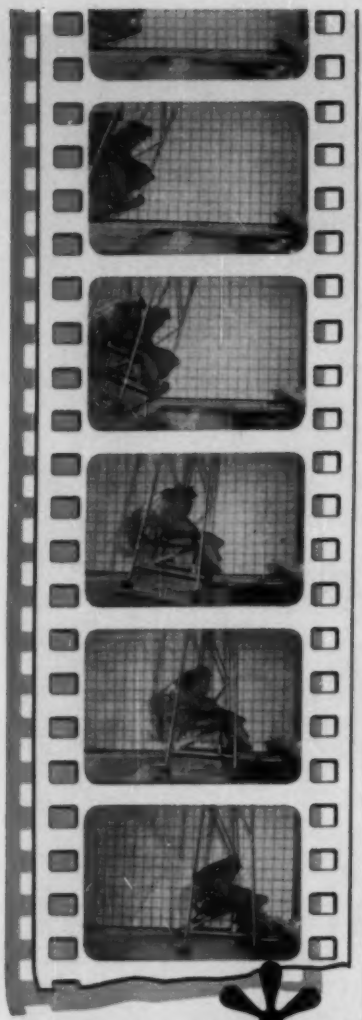
Captain's Statement

These, he said, were given in rapid sequence and he recalled no response from Flight 258 for any of them. The captain stated the reports occurred after his flight reached runup position, about 2324, and thought the accident and one-eighth mile report occurred close together but could not recall which occurred first. He did not know the time of the accident nor was he able to state with accuracy the times of the other events which occurred or the sequence in which they happened.

According to the Otis RAPCON transcription, at 2327 Flight 258 did not respond to a call from Otis but before 2328 returned to the Otis frequency. At 2328, in response to an inquiry, Flight 258 stated it had not started procedure turn but was ". . . just past the marker outbound." Thereafter, at 2330, the flight transmitted "and Otis this is Northeast 258, procedure turn." Otis responded, "Roger, Northeast 258 change to company." There were no other communications between the flight and Otis.

At 2330 special observation number 21 was logged by the Weather Bureau observer as "partial obscuration, one-eighth mile visibility, fog." This was given Northeast immediately, according to the observer, and it was the testimony of the senior Northeast agent that he prompty transmitted it to Flight 258. He stated he gave the information twice with a substantial pause between each transmission and while there was no verbal response from Flight 258 he recalled a sound over the radio which he thought was a "mike click." He said the sound followed each of the two transmissions of one-eighth mile visibility.

The captain of 2289 did not hear this sound nor did he click his microphone. The senior agent estimated that the action occurred during a 60-90 sec. interval before he logged it at 2333. He also stated that at no time was a one-fourth mile visibility report given over the radio. Examination of the Weather Bureau observation log re-



Here's how TECO pulls the "Stop" on high G's!

Gruelling tests, high-speed film sequences, concentrated engineering follow-through and confident investment in TECO-ability have paid off by making available the finest Energy Absorption unit for airline seats.

* For complete "How" facts on TECO Energy Absorption, or to see a run-through of the entire technical film—write: TECO, Inc., 3210 Winona Ave., Burbank, Calif.

TECO Aircraft Seats

Burbank, California

STRUCTURES ENGINEERS

Exceptional opportunities are available for Structures Engineers on our B-70 and F-108 weapon systems and X-15 manned space aircraft.

Stress Analysis—Rigorous design requirements necessitate extensive structural investigation of the influence of high temperatures and unconventional external loadings. Stress engineers concerned with such structures will have the opportunity to utilize their technical knowledge to the fullest extent in the development of new analysis methods.

Load Analysis—Corresponding demands on the structural loads engineer have also created unique careers with significant potential in the fields of dynamic loads, aeroelastic loads, loading spectra, flight load data analysis, and digital and analog computer programming.

Weight Analysis—Exacting air vehicle performance requires the optimization of structural design layouts to produce the lightest weight configurations. Weight engineers with experience in stress analysis are required for the formulation of advanced weight estimation and control procedures.

For details about these positions please write: Mr. A. E. Stevenson, Engineering Personnel, North American Aviation, Inc., Los Angeles 45, California.

THE LOS ANGELES DIVISION OF NORTH AMERICAN AVIATION, INC.

flected no one-fourth mile observation and the Weather observer stated he made no such observation.

The senior agent testified that the next occurrence was a report of a fire in the approach area to runway 24. This was transmitted by Flight 2289. The agent testified he stepped outside, looked toward the area, and because of the fog saw nothing. He then returned and logged the report at 2336 which he estimated was about one minute after the report was transmitted to him.

The Nantucket Memorial Airport is located on the south central side of the Island. It has no tower and is equipped with two crossing runways. Each is 4,000 ft. in length and 150 ft. wide although at the time of the accident runway 6–24 was being extended to 5,000 ft. This work at the southwest end restricted the usable length to approximately 3,800 ft. The airport has a regular clear-green, medium-intensity, 3,000,000-candlepower rotating beacon.

Runway 24 is the instrument approach runway. There is no ILS (Instrument Landing System) or ladder-type approach light system. The instrument runway, as well as the others, is equipped with conventional threshold lights and medium-intensity elevated runway lights of low-, medium-, and high-intensity settings.

The strobe lights previously noted were designed as a visual lighting aid to the instrument approach. They were installed by Northeast Airlines after considerable testing for this purpose. The condenser discharge lights were located 250 ft. from the threshold lights, 150 ft. apart, in the approach area. They flash two times each second emitting a beamed white light rated at 10,000,000 candlepower.

Technical Witness

A technical witness stated the beam was projected into the approach zone at an angle of 34 deg. above horizontal so that the lower side of the projected beam would be 300 ft. above the ground over the "H" facility located six-tenths of a mile from the runway threshold. This position and altitude would be coincident with the approximate position of an aircraft at minimum altitude during the instrument approach.

The witness stated what below the projected beam the light diminished rapidly and estimated it would be diminished 75% approximately 50 ft. below the lower edge of the beam.

The record indicates that the strobe lights were on several minutes before the accident and clearly shows that airport beacon, threshold lights, and runway lights were on, the latter set to high brilliance.

The reported weather conditions required that Flight 258 execute a straight-in VOR instrument approach. For the procedure the ground radio facilities consisted of the VOR station located 1.9 mi. from the runway threshold and a Northeast-owned and maintained "H" facility (a low-power nondirectional radio beacon) positioned six-tenths of a mile from the threshold of runway 24, between the VOR station and runway on an inbound track of 240 deg. The manuevering area for the approach is over relatively flat unobstructed terrain with the elevation of the runway 47 ft. mean sea level.

The CAA-approved VOR instrument approach procedure required establishment of a 60-deg. outbound track after station passage. This is followed by a standard procedure turn on the north side of the track within 10 mi. of the VOR station. Minimum altitude in the procedure turn is 1,300 ft.

An inbound track of 240 deg. is then required to again cross the VOR station and "H" facility to the runway. Minimum altitude over the VOR is 600 ft. after which descent is permissible to the appropriate landing minimum altitude. Flown in a normal manner the approach procedure from the VOR station outbound to the VOR station inbound requires about five minutes. In the Convair about 55 sec. are required from the VOR to the runway threshold.

The basic weather minima for the VOR straight-in instrument approach at Nantucket are ceiling 400 ft., visibility one mile. According to the ACA Form 511, with both the VOR and "H" facility in operation, the minima for Northeast Convair flights are ceiling 300 ft. and visibility one mile.

CAA witnesses testified that these minima were the result of a deviation authorized by the CAA after the carrier requested it. It was stated that such deviation is provided for in Civil Air Regulations and, because it required no significant deviation from the approach obstruction criteria, it was permissible for the local CAA office to grant the request. After consideration of many factors involved, this was done.

It was explained that the carrier was authorized the "Sliding Scale" which is a provision of the Operations Specifications applicable to the straight-in approach. Operations Specifications are rules of particular applicability prepared and issued by the Civil Aeronautics Administration under the enabling provisions of Part 40 of the Civil Air Regulations. Under "Airport Authorization and Limitations" it is stated, "For each increase of 100 ft. above the minimum ceiling specified, a decrease of ¼ mi. in visibility is authorized, until a visibility of ½ mi. is reached." Because at the time of the accident a partial obscuration, which does not constitute a ceiling, was reported, the "Sliding Scale" was therefore applicable to Flight 258 and it was authorized to make the approach in ½ mi. visibility. The authorized minimum altitude of 300 ft. was unaffected by the "Sliding Scale" provision.

It is important to note the responsibilities required of the pilot involved when below-minimum weather conditions are reported to a flight during an instrument approach.

Civil Air Regulations Part 40, Section 40.406(d) is applicable and states, "If an instrument approach procedure is initiated when the current report prepared by the U. S. Weather Bureau or by a source approved by the Weather Bureau indicates that the prescribed ceiling and visibility minimums exist and a later weather report indicating below minimum conditions is received after the airplane (1) . . . (2) is on a final approach using a radio range station or comparable facility and has passed the appropriate facility and has reached the authorized landing minimum altitude (3) . . . such approach may be continued and a landing may be made in the event weather conditions equal to or better than the prescribed minimums for the airport are found to exist by the pilot in command upon reaching the authorized landing minimum altitude."

Except under the aforestated conditions, the approach should be discontinued. Obviously, to meet the terms of this regulation the below-minimum weather report must be received by the pilot.

The conditions necessary for a descent below minimum altitude during an instrument approach for landing are stated in Air Carrier Operations Specifications. Item 32 of these rules under "Limitations on Descent Below Authorized IFR Landing Minimums" states, "No aircraft shall descend below the minimum altiude for landing specified in the applicable Form ACA-511 unless clear of clouds. Thereafter, except when landing minimums of 1000-2 or better are authorized, no aircraft shall descend more than 50 ft. below such altitude, unless (1) it has arrived at a position from which normal approach can be made to the runway of intended landing, and (2) either the approach threshold of such runway or the approach lights or other markings identifiable with such runway are clearly visible to the pilot. If, at any time, after descent below the clouds the pilot cannot maintain visual reference to the ground or lights, he will immediately execute the appropriate missed approach procedure prescribed in the applicable Form ACA-511."

The testimony of Northeast supervisory operational personnel indicated that "other markings identifiable with such runway" need not be located at the runway threshold and need not be markings which are part of the runway threshold complex.

Company witnesses stated it was their interpretation that the markings should be of a permanent immobile nature and named as examples "a city dump, a swath through trees, and a distinguishing feature of a shore line."

It was the testimony of CAA Air Carrier Safety Agents associated with Northeast that only markings located at the threshold area of the runway which were a part of the threshold complex could be considered "other markings identifiable with such runway".

Unsatisfactory Interpretation

These witnesses indicated the Northeast interpretation was unsatisfactory to them and until the hearing were unaware of the Northeast interpretation. From all the testimony surrounding the subject it was obvious that the wording of the specification did not state a clear meaning.

Investigation disclosed there were several 55-gal. drums spaced along the extended centerline of runway 24. The drums were spaced along this line for a distance of 1,700 ft. beginning at the "H" facility and extending toward the runway. The tops of the drums were painted white. The testimony of Northeast officials indicated the drums were put there at the instance of the company in 1953 and originally extended from the "H" facility to the runway threshold, but those which originally were located over the last 1,800 ft. were removed to satisfy a problem they created relating to use of the land.

Company witnesses stated the barrels were intended to identify a ground position over terrain which had no other distinguishing features or contrast.

It was the testimony of the assistant chief pilot that the barrels were not intended to lead the pilot to the runway threshold and

We promise you will receive a reply within one week!

NEW OPENINGS AT HUGHES RESEARCH & DEVELOPMENT LABORATORIES

Hughes has several hundred openings for engineeers and physicists whose training and experience are applicable to the research, development, design and testing of airborne electronic equipment for use in supersonic military aircraft; in solid state physics, nuclear electronics, industrial dynamics, and related areas.

Use of the following form will, we hope, reduce to a minimum the inconvenience of submitting an employment inquiry, yet will still permit us to give you a reasonably definitive reply.

Please airmail to:
Mr. Robert A. Martin, Supervisor, Scientific Employment
Hughes Research and Development Laboratories
Culver City 29, California

HUGHES

© 1959, HUGHES AIRCRAFT COMPANY

Name _____

Address _____

City _____ *Zone* _____ *State* _____

College _____ *Degree* _____ *Year* _____

I am interested in one of the following types of assignment:

- ☐ RESEARCH
- ☐ DEVELOPMENT
- ☐ PRODUCT ENGINEERING
- ☐ TECH. ADMIN.
- ☐ SYSTEMS
- ☐ FIELD TEST
- ☐ OTHER: _____
- ☐ _____

I have had professional experience in the following specific areas:

- ☐ CIRCUIT ANALYSIS AND DESIGN
- ☐ DIGITAL COMPUTERS
- ☐ GUIDANCE DEVICES
- ☐ MICROWAVES
- ☐ STRESS ANALYSIS
- ☐ INDUSTRIAL DYNAMICS
- ☐ MATERIALS
- ☐ SYSTEMS ANALYSIS
- ☐ R-F CIRCUITS
- ☐ RELIABILITY
- ☐ ATOMIC AND/OR SOLID STATE PHYSICS
- ☐ INSTRUMENTATION
- ☐ ELECTRO-MECHANICAL DESIGN
- ☐ OTHER: _____
- ☐ _____
- ☐ _____

I have had a total of _____ years of experience.

that it was doubtful if the barrels could be seen at night, especially in poor visibility. Company supervisors also stated the barrels did not qualify as "other markings identifiable with such runway" because they could be moved and thereby lacked the permanency required. It was stated that no operational aspect of the instrument approach procedure was predicated on the barrels. The assistant chief pilot did not recall any company material issued to its pilots explaining the purpose of the barrels or that the installation had been made. He stated, in response to questions, that it was conceivable a pilot might use the barrels as a guide to the runway in poor visibility or might consider them as "other markings . . ."

Several persons located at the Nantucket Airport terminal saw Flight 258 when it initially arrived over the vicinity of the airport. Most stated this occurred a few minutes before the crash and that the aircraft was viewed through breaks in heavy fog flying on an easterly or northeasterly heading.

Another witness, a highly qualified pilot and thoroughly familiar with the VOR instrument approach procedure, also saw the flight. He was located about 1¼ mi. west of the airport. He stated that he recognized the aircraft as a Convair and when he first saw it, it was on an easterly heading.

While he watched, the flight turned left to a northeasterly heading and proceeded toward the VOR station. He said the flight at this time appeared to be intercepting the 60-deg. inbound radial. Being familiar with the location of the VOR station he estimated that the flight overheaded the facility. He discontinued watching as the aircraft proceeded northeasterly toward the procedure turn area. He testified that it was evident that the instrument approach procedure was in progress and surmised that instrument weather must have existed at the airport although at his location the weather was clear. The witness stated that the aircraft was clearly visible and it looked and sounded normal.

Several persons located northeast and northwest of the VOR station saw the aircraft. Most observed it casually and stated it was then flying southwest toward the airport. One, located about 1¼ mi. northeast of the VOR, stated the aircraft seemed low and estimated it to be about 200–250 ft. above the terrain. Nearly all said it looked and sounded normal, and again the weather conditions in this area were described as generally clear.

There was no reliable description of the flight path of the aircraft from the area of the VOR to the crash.

Wtinesses at the terminal, about one mile from the crash site, said that fog became evident at the airport about 2300 and thereafter until the crash it became very dense. The fog was described as sea fog which moved in from the ocean in layers and waves. It moved northeasterly from the ocean across the airport into the approach area of runway 24. Some noted the lights of Flight 2289 which was waiting takeoff about one-half mile from the terminal. They stated these lights were visible a few minutes before the crash but at the time of the accident they were blotted out in fog.

One witness at the terminal said that he

The best way to keep a piece of metal from having heat-stroke is to cool it.

That's just what engineers of the TAPCO Group have done with turbine-engine blades to increase the operation temperature and efficiency . . . without overheating them.

Precisely-located, precisely-sized radial holes through the blades carry blasts of cooling air from root to tip. This allows turbine inlet temperatures to be increased as much as 200°F safely, efficiently.

To know more about TAPCO capabilities to make air-cooled blades and vanes, as well as systems and components of any space-age vehicle, write to the address below.

TRW

TAPCO GROUP

Thompson Ramo Wooldridge Inc.

Dept. AW-559 • Cleveland 17, Ohio

- SELF-ALIGNING
- 1000 CONNECTIONS
- PRODUCEABLE in large or small quantities
- LOW PRESSURES for insertion and extraction
- HUMIDITY ... 0% to 100%
- ATMOSPHERE ... air, water, salt water, jet fuel, exhaust gases, oil, hydraulic fluid
- PRESSURE ... 0 to 30 p.s.i.a.
- OPERABLE by mechanical manipulator
- * TEMPERATURE ...—65°F to 1000°F
- VIBRATION ... 100 Gs (See Wyle Report below)
- POSITIVE LOCK-UP and trip-free disconnect
- * RADIATION LEVEL ... 1,000,000 Roentgens per hr.
- EXPLOSION PROOF
- DEAD FRONT
- SEQUENCE SWITCHING
- LIGHT WEIGHT
- HERMETICALLY SEALED
- TROUBLE FREE
- LOW TOOLING COST
- HIGH VOLTAGE

Under development

Many tough electrical connector problems have been submitted to Cole Electric Co. in recent months. Because of the ability of revolutionary new Cole self-aligning ball-and-socket connector pins to operate under extreme conditions, all of these problems have been or are being solved. Special Cole Connectors with up to 1000 contacts have been developed to meet difficult environmental and operational requirements for aircraft, missiles, ground support, computers, nuclear, electronic and electrical equipment.

Whatever your connector problem might be, a special Cole Self-Aligning Connector may provide the practical solution. Virtually any size or configuration with any number of contacts can be made. Four pin capacities: 15, 30, 75 and 300 amp. Highly specialized fittings in stainless, phenolics, fiber glass, nylon, ceramic or other materials.

Our complete research and development facilities are at your disposal. Write or phone today.

Cole ELECTRIC CO.

8439 Steller Dr., Culver City, Calif. • TE 0-4701

Tested to 100 Gs

In recent tests conducted by Wyle Laboratories of El Segundo, Calif., Model B-3106 Cole Connectors were subjected to vibration scan from 5 to 2000 cps. Each connector contained 15 contacts, wired in series. At vibrations up to 100 Gs amplitude there was no evidence of contact opening. Noise levels were exceedingly low. Full test report available on request.

observed the right or rear side of a heavy fog bank moving with the other fog across the airport. This, he said, blotted out the lights of the DC-3 (Flight 2289) and was moving toward the approach area. While watching for Flight 258 to land he saw a light appear, the beam of which, he said, was triangular, narrow at the top and broad at the bottom. This he thought was the landing lights of Flight 258.

The light appeared only momentarily but it was sufficient to illuminate the fog bank and to outline the right or rear side and the top; the latter was estimated to be about 200–250 ft. above the ground. He said the light emanated from behind or from within the fog bank.

Several others saw a light; however, they described it as an explosive-like flash at ground level.

The description of the weather conditions by the weather observer on duty did not differ substantially from the description given by ground witnesses. He noted that stars were visible through breaks in the fog and estimated the fog was about seven-tenths coverage at 2311, increasing to nine-tenths coverage at 2330. He stated that when he took the one-eighth mile observation he thought the fog seemed fairly uniform and at that time he did not note a fog bank as such but being outside only for a short period he could have been in it at the time.

The observer said that in his experience it was not unusual to have a heavy fog at the airport with the surrounding areas generally clear. The observer testified that in measuring the one-eighth mile visibility there were references which showed the visibility to be equal to this value and not less. He said, however, that measuring visibility at Nantucket was hampered by the lack of reference in all quadrants and at varying distances.

The weather observer testified that, according to Weather Bureau procedures, after physically obtaining the observation data he returned to the office where it was recorded in the Weather Bureau log. He stated that the time affixed in the log was observed at or near the completion of the recording and immediately the information was passed to Northeast over the intercom. He said their normal procedure was then to type the observation and give it to CAA for teletype transmission. The witness said this procedure was followed on the night of the accident and estimated that no more than 15 sec. transpired from the log entry time of his observation until it was passed to Northeast.

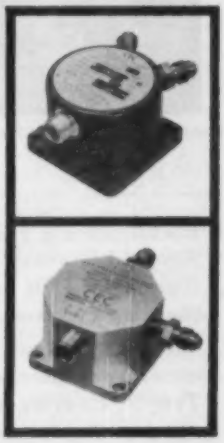
According to the existing Weather Bureau procedure at the time of the accident, special weather reports were teletyped to Otis RAPCON on the scan periods (20 and 40 min. past the hour). Special weather observations between these periods were not available to this control facility although Northeast flights were in communication with Otis during important phases of the instrument approach and, as noted, when communication with the company was precluded.

Witnesses at the public hearing agreed that all important weather reports should be available immediately to Otis so they could be furnished to a flight when on the Otis radio frequency.

A similar situation existed with respect to the transmission of weather information

TWO POTENTIOMETER PRESSURE PICKUPS

Designed for missile applications, these two pot pickups, the 4-380 for low pressure and the 4-381 for high pressure, are built to exceed severe environmental requirements for in-flight measurements. Rugged construction provides both pickups with a high order of accuracy and reliability for missile work.



Low Pressure Type 4-380 Measures absolute, gage, or differential pressures in ranges from 0 to 100 psi. A miniaturized assembly of counter-balanced flexure pivot design is connected directly to the pressure summing capsule and is capable of withstanding mechanical shocks up to 75 g's without damage or calibration shift. The internal element is hermetically sealed and completely isolated from the pressurizing media.

High Pressure Type 4-381 For extremely accurate pressure measurements, in the ranges from 0 to 100 up to 0 to 5000 psi, this gage, absolute, or differential Bourdon-tube pickup incorporates a unique wiper arm which eliminates all mechanical multiplication linkages, thus enhancing the pickup's repeatability and resistance to vibration. The pressure sensing element is oil immersed for damping and is isolated from the pressurizing media. The stainless steel case is fail safe to 7500 psi.

For complete information, call your nearest CEC sales and service office or write for Bulletins 1604-X12 and 1611-X9.

Transducer Division CEC

CONSOLIDATED ELECTRODYNAMICS/300 n. sierra madre villa, pasadena, california

FOR EMPLOYMENT OPPORTUNITIES WITH THIS PROGRESSIVE COMPANY, WRITE DIRECTOR OF PERSONNEL

Y.C. Lee

His full name is Yuan Chu'en Lee, but to most of us at Aerojet, he's known as "Y.C." As Director of Corporate Research, Y.C. is in charge of our astronautical, other-planetary endeavors.

Y.C. and his associates are grappling with the knottier questions of space technology and advanced propulsion. They're studying advanced magnetohydrodynamics, extraterrestrial physics, and relativistic problems. They're looking for new fuels based on ions, gaseous free radicals, and nuclear plasmas.

Fundamental research has kept Aerojet at the forefront of the rocket field. Thanks to people like Y.C. and his team, we'll stay there.

That team, by the way, is hand-picked. It's one of several such groups at Aerojet that offer opportunities of unusual scope to the scientific and engineering imagination. Let us see a resume if this is your kind of challenge. The address: AEROJET-GENERAL CORPORATION, P.O. Box 296, Azusa, California or P.O. Box 1947, Sacramento, California. Attn: Director of Scientific and Engineering Personnel.

AEROJET-GENERAL CORP.

THE GENERAL TIRE

AZUSA AND SACRAMENTO, CALIFORNIA • A SUBSIDIARY OF THE GENERAL TIRE & RUBBER COMPANY

to the Boston Northeast dispatch office. This, it was stated, resulted in a lack of timely weather information and hampered in some degree the execution of dispatching responsibility.

Investigation at the accident scene disclosed that N 90670 initially contacted the ground approximately 1,450 ft. short of runway 24 and about 650 ft. to the left (inbound) of the extended runway centerline. The initial contact was shown by light tire tracks made by the tires of all three landing gear components. The lightness of the tracks in soft ground showed the aircraft had little, if any, rate of sink or descent at initial contact.

Tracks Studied

Because all the tracks began nearly simultaneously it was also evident that the aircraft was nearly level laterally and longitudinally. Tire tracks by all landing gear components continued for about 145 ft. along a magnetic heading of 233 deg. and over bumpy but flat terrain which averaged about 50 ft. mean sea level.

There was a series of 14 left propeller cuts in the ground across the left tire tracks, beginning after about 50 ft. of rollout and spaced over a distance of 100 ft. The first three cuts, about three to four inches deep, were well defined and the distance between the first and second cuts was 4.1 ft. The later slashes were of lesser depth and about equal in width to the blade chord showing that the blades were being treated and bent rearward as the cuts progressed. Obviously, such deformation destroyed the propeller function.

The wheel tracks ended after about 145 ft. when the wheels contacted a sharp but not high rise in the ground and the aircraft catapulted into the air. It crossed a dirt road and passed through a clump of scrub pine trees.

A branch of one of these trees was marked by a blade of the right propeller. Examination of the cut showed it was made at the bottom of the propeller arc and by the tip of a blade.

This information and the height of the mark showed the aircraft was rolling rapidly left at this point.

Approximately 400 ft. from the initial ground contact the left wing struck the ground and progressively disintegrated as it dragged for the next 300 ft. The aircraft entered a scrub pine thicket cutting a swath the narrowness of which showed the aircraft was then nearly vertical in its roll axis.

Magnetic Heading

The aircraft veered left to a magnetic heading of 190 deg. and reached an attitude slightly past inverted. Nose down in this attitude the aircraft plunged to the ground making simultaneous contact with the right wing and powerplant and the nose section of the airplane. The center section and fuselage then cartwheeled forward to an upright attitude and, on a magnetic heading of 205 deg., slid 125 ft. to a stop, some 1,100 ft. from the initial contact.

The fuselage stopped, facing across the wreckage path, and the center section, broken from the fuselage during the cartwheel and slide, faced about 90 deg. to the left of the fuselage.

Fuel from the shattered wings was hurled into the main wreckage area and ignited. The resulting fire consumed a major portion of the wreckage.

All major components of the aircraft, including flight control surfaces, were accounted for in the wreckage or along the ground path. All attach fittings were secure or there was ample evidence indicating they were secure before the ground impact. It was determined all doors and access panels were closed and secure at impact. There was no evidence of fatigue failure and from the examinable structure there was no suggestion of inflight failure.

The control system could be traced only from fuselage station 200 rearward because of complete impact and fire destruction to the forward fuselage and cockpit areas. Within the examinable area there was no evidence of control malfunction or failure.

Examination of the landing gear components disclosed the right main gear was retracted and locked. It also revealed the left main and nose gears were in the retraction cycle when early impact forces severely damaged the retraction mechanisms and tore off the nose gear. Later in the sequence the left gear was also torn off. Examination of the flap gear box showed the wing flaps were extended about 15 deg. when the aircraft came to rest.

Both powerplants were in the main wreckage area. The No. 1 (left) powerplant was torn out and came to rest adjacent to and facing the center section of the aircraft. The No. 2 (right) engines, also torn out, was located back along the wreckage path about 40 ft. from the main fuselage.

The nose section and propeller were broken off and located about 75 ft. from the engine. Both engines received ground fire damage; however, there was no evidence of fire in flight. A detailed examination revealed no indication of engine malfunction or failure or other conditions which would adversely affect their normal operation prior to impact.

Propeller Examination

Both propellers were tight on their shafts and although all blades were bent or broken the blades or stub ends remained in their hubs. Examination of the spider shim plates revealed impact markings. These, when measured to determine the propeller blade angles, disclosed an angle of 37 deg. for the left propeller blades and an angle of 43 deg. for the right.

The propeller governors were bench checked to ascertain the rpm. settings. Results showed settings of 2,330 and 2,362 for the left and right governor, respectively, and closely approximating 2,300 rpm. normally used during the approach.

Using an rpm. of 2,330 and the distance of 4.1 ft. between the first and second propeller slash in the ground, the resulting computation of groundspeed for the aircraft when the cuts were made was 126 kt. This, allowing for the effect of the reported surface wind, indicated an airspeed of 131 kt. Further computations using the groundspeed, propeller blade angles, and rpm. permitted an estimate of power being developed at the instant the shim plates were marked, for the left engine when its propeller slashed the ground and for the right engine at final impact, or approximately five seconds later.

The resultant estimates were 1,342 bhp. (brake horsepower) and 2,450 bhp. for the left and right engines, respectively. The values also approximate approach power for the left engine and maximum power for the right.

Nearly all of the radio communications and navigational equipment sustained severe and extensive impact damage. In some instances only fragmentary portions of this equipment were recovered.

The VHF (very high frequency) communications transmitter and receiver and the HF (high frequency) transceiver were destroyed. Both VHF navigation receivers were crushed and inoperative; however, the tuning dial for the first officer's was found indicating 117.0 mc., the Nantucket VOR frequency. The captain's tuning dial showed 115.4 mc., an unrelated setting. Both omni bearing indicators showed approximately 60 deg.

Omni Mag Indicators

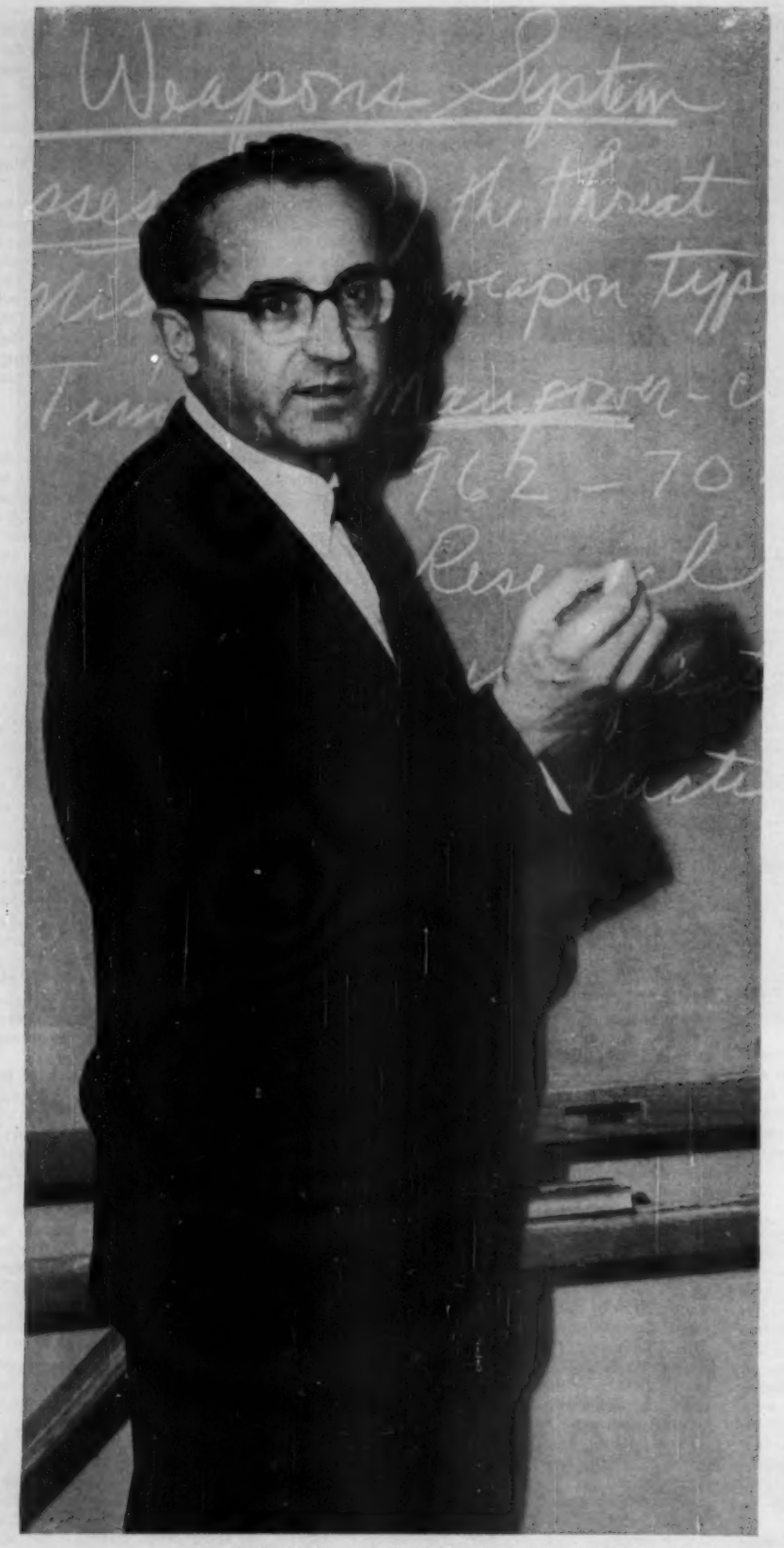
Both omni mag indicators were badly damaged, inoperative, and could not be tested. Reassembly of the course selector gears of the captain's instrument revealed a course selection of 240 deg. The "To-From" indicator indicated "From." The comparable instrument from the first officer's position showed a course selection indication of 24-, the last digit obliterated. It may be recalled that the inbound track of the instrument approach is 240 deg.

After replacing broken tubes the first officer's ADF (automatic direction finder) was operable but with low sensitivity. The captain's was damaged beyond testing. The tuning condensers showed 244 kc. and 236 kc. for the left and right positions, respectively; however, both showed evidence of having been pulled and shifted by impact. The "H" facility frequency to which at least one of these units would normally be tuned is 224 kc.

Of the gyrosyn instruments, the two gyrosyn compasses and one of the two gyrosyn amplifiers were recovered. One of the compasses, though badly mutilated by impact and fire, showed an indication of 190 deg. which closely approximated the final ground impact heading. The other compass provided no useful information. The amplifier when checked functioned normally.

The top plate assembly from each of the two flight altimeters was recovered although its installed position (right or left) could not be determined. Both assemblies were badly crushed and burned and partially melted away. Using the fragmentary evidence available it was concluded that one altimeter was set at 29.92 and the other at 29.65 when both were subjected to intense fire. There was evidence indicating that an object was thrown against the setting knob of the latter assembly causing it to turn and change the setting before being exposed to the fire. The latest altimeter setting furnished the flight was 29.91.

During the public hearing the company vice president of operations and the assistant chief pilot described the company's operational policies and procedures relating to initial pilot selection, pilot training and upgrading, and continued pilot proficiency. In general, the testimony described policies and procedures which intended a program within their areas comparable to those of other air carriers. In some areas, however, the adequacy of implementation of the program



I READ BUSINESS WEEK

"Today, science and management are inseparable worlds. In the highly technologically based industries, we must use both tools. That is why we rank Business Week with our best scientific sources."

DR. CLEDO BRUNETTI
Vice-President &
General Manager
Grand Central Rocket Co.
Redlands, California

A McGraw-Hill Magazine

YOU ADVERTISE IN BUSINESS WEEK WHEN YOU WANT TO INFLUENCE MANAGEMENT MEN

and consequently its effectiveness was questionable.

Concurrently with the accident investigation the CAA undertook an operational inspection of the carrier. It was undertaken under the CAA responsibility for the supervision of air carrier operations and was prompted by three fatal accidents experienced by the carrier since 1956. The inspecting team was composed of several air carrier safety inspectors other than those assigned to the Boston office. It functioned under the Regional Administrator.

The accident investigation by Board investigators and the conclusions reached by the CAA team were similar in several areas, some of which have already been presented. Of other areas, one of the most important was operational training which was considered inadequate, the result of several factors.

Testimony of Northeast witnesses indicated that the use of Northeast aircraft in the scheduled operations took priority over their use in training. Board investigators determined that at times this resulted in interruptions of the training function and reduced the over-all effectiveness of the program. The CAA team concluded that inefficient scheduling of aircraft over the system reduced the availability of aircraft for training. Lack of training personnel also contributed to the problem.

The CAA team indicated that undesirable factors in the pilot check program contributed to the evaluation. It concluded that there was a need for greater standardization of flight check procedures among the check pilots and more explicit instructions to them regarding their duties and responsibilities. The team concluded that supervisory personnel needed delegated authority commensurate with their positions. Allied to the check program was a requirement for greater stress on the importance and use of recurrent training.

During the CAA inspection, Northeast captains received flight proficiency checks. The results substantiated the conclusions of the team when a number of these pilots were graded unsatisfactory on their first check.

It was the testimony of the local CAA air carrier safety inspectors having responsibility for the supervision of the operational phases of the carrier that, in general, they were satisfactory. Obviously this judgment was not in accord with the CAA inspecting team.

During the accident investigation Board investigators found it difficult to determine, from the available company records, some of the current qualifications of line pilots. It was learned that some of the information on which the company relied was submitted by each pilot rather than being obtained from the record system.

ANALYSIS

Available evidence indicates that except for a late departure Flight 258 operated in a normal manner to Nantucket. Position reports, requiring the use of navigational equipment, and other communications from the flight gave no indication of operational or equipment difficulty. Although portions of the aircraft wreckage were destroyed or badly mutilated no evidence was found to indicate the aircraft or its equipment contributed to or caused the accident.

It is believed that at or about 2311 the

POURED PRODUCTS *with* **STAFOAM**

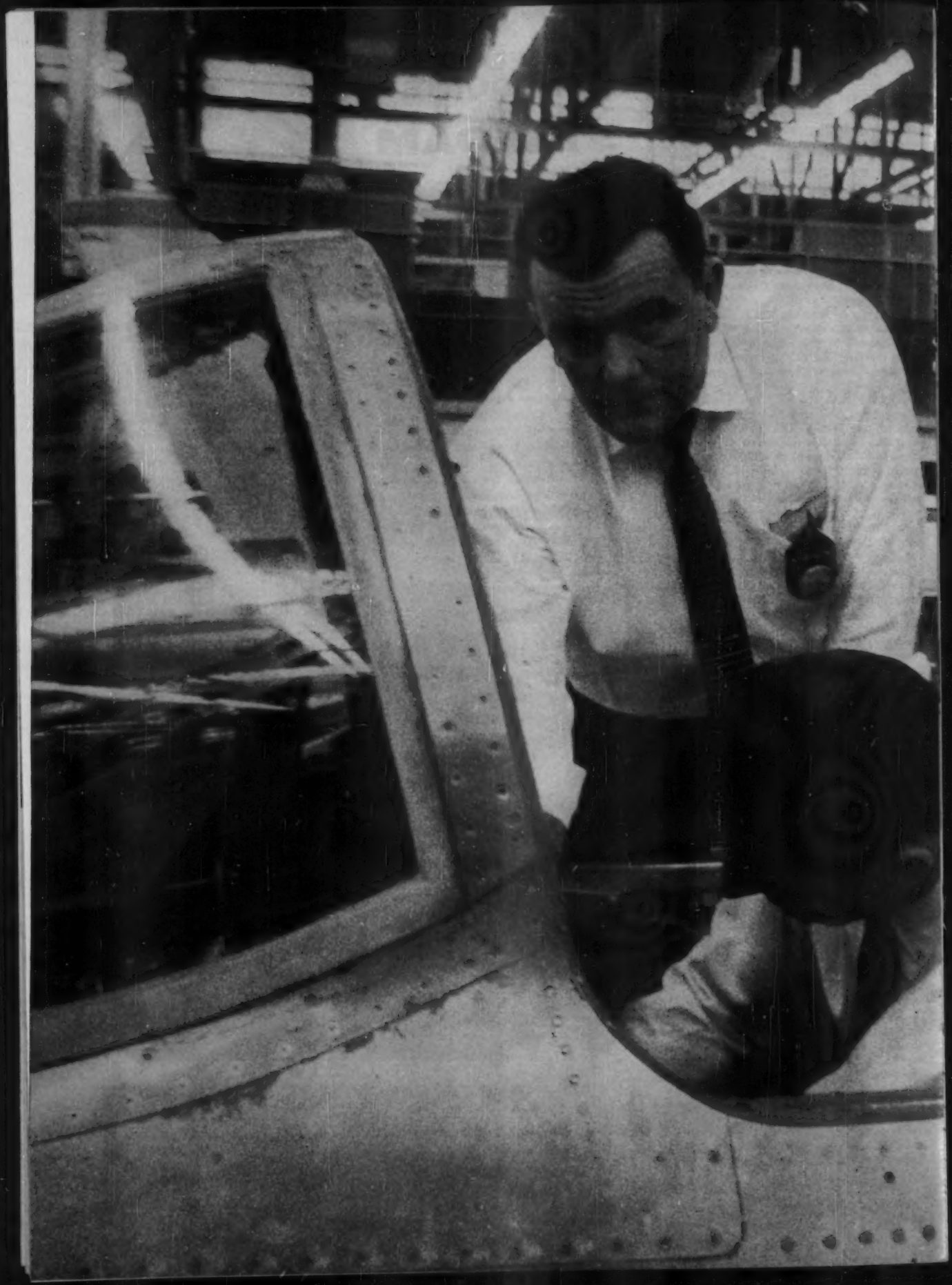
by American Latex are destined to change the manufacturing habits of the nation

STAFOAM, the miraculous "foamed in place" rigid or flexible polyurethane by American Latex Products Corporation, is applicable for an infinite variety of manufactured items. Proven to possess the required characteristics of lightweight, superior strength, smooth surfacing, temperature resistance and ease of application, STAFOAM is destined to change our material world. Its present use in American Industry alone confirms that destiny.

The new Freedlander Research and Development Center at Hawthorne, Calif, devoted entirely to the development of STAFOAM *applications, invites you to call or write for research and/or manufacturing information.*

American Latex
Products Corporation
3341 West El Segundo Blvd., Hawthorne, California
OSborne 6-0141 • ORegon 8-5021
A DIVISION OF THE DAYTON RUBBER COMPANY

stafoam



BASIC TEST FOR MEDIA SELECTION:

Ask anyone, anyone you're trying to sell in the aviation market, what publication he reads and respects most.

A powerful editorial force is a powerful selling force.

Aviation Week

Including **Space Technology**

A McGraw-Hill Publication 330 West 42nd St. New York 36, N. Y.

Aviation's largest engineering-management audience.

ABC PAID CIRCULATION 71,950

ENGINEERS AND SCIENTISTS

FOR COMPLETE

SPACE AND WEAPONS SYSTEMS

AND COMPONENTS

Rarely does a corporation of United Aircraft's stature make available such key positions. Ordinarily these openings would be filled from within, but as the other divisions (Pratt & Whitney, Sikorsky, Hamilton Standard, Norden) cannot spare additional valuable staff men, these openings must be filled from the outside. You will work beyond ordinary boundaries on

MISSILE AND SPACE PROJECTS

Unusual, infrequently offered, high level positions for:

ELECTRONIC ENGINEERS
AERONAUTICAL ENGINEERS
MECHANICAL ENGINEERS
PHYSICISTS

Please reply to Mr. John North, Engineering Dept.

MISSILES & SPACE SYSTEMS
A Division of
UNITED AIRCRAFT CORP.
432 Main Street, East Hartford, Conn.

NEW PROGRAMS

have created

IMMEDIATE OPENINGS

for top quality engineers with experience in—

Preliminary Analysis
Aerodynamics
Flight Dynamics
Structural Dynamics
Aero-Thermodynamics
Flight Simulation
Space Communication
Space Instrumentation
Radar Systems & Techniques
Electronic Countermeasures
Guidance
Instrumentation
Electronics Test
Design
Computing
Reliability
Human Factors

Well paid jobs for qualified people.
Relocating expenses paid.
For information on these and other engineering positions, write:

B. J. Ralph, Dept. 451A
Missile Division
North American Aviation, Inc.
12214 Lakewood Blvd.
Downey, California

MISSILE DIVISION
NORTH AMERICAN AVIATION, INC.

flight was given the Nantucket 2311 special weather observation of "partial obscuration, visibility ¾ mi." This is supported by the Northeast agent who stated it was given and by an appropriate entry in the Northeast radio log. Receipt of the information is supported by action of the flight when, shortly thereafter, at 2314, it contacted Otis, asked for, and received an instrument approach clearance. Because the flight had operated VFR before this and reported it was "visual" when the clearance was requested it would be logical to assume the crew knew IFR conditions existed at Nantucket and therefore requested the IFR clearance.

As indicated earlier, the Board is of the opinion that the landing information given the flight and logged as being given at 2314 was in fact given just before 2326, the original entry. This opinion is supported by several factors. First, Flight 258 informed Otis at 2324 it was going to company frequency to obtain this information. Second, logic dictates that such information would normally be requested by an inbound IFR flight two to three minutes before on instrument approach rather than 14 min. This is especially true in deteriorating and near-minimum weather conditions which existed. Furthermore, for these reasons the Board believes the surface observation would be requested again or would be given as a matter of practice by the radio operator with the landing instructions. Therefore, in all probability the "partial obscuration, visibility ¾ mi." report was repeated at 2326. This would account for the crew of Flight 2289 having heard this report given to Flight 258 about that time.

There is no question that the special observation of "partial obscuration, ½ mi. visibility" was transmitted by the Northeast senior agent. Because the crew of Flight 2289 did not hear an acknowledgment and the radio log did not reflect one, there was a question of whether or not Flight 258 was on the company frequency when the weather information was transmitted.

This information was available to the senior agent immediately after 2327 and according to his testimony it was immediately given to the flight. This was completed and the action was logged at 2328. The Otis tape shows that Flight 258 did not return to that frequency until 2327:40, therefore, the Board is of the opinion the flight was on company frequency when the weather report was issued. This analysis permits the Board to accept the recollection of the senior agent which should have been most vivid, recalling the personal conversation that transpired between himself and First Officer Carey when the one-half mile visibility report was issued.

A question of even greater concern is whether or not Flight 258 received the special weather report of "partial obscuration, visibility ½ mi." and, if so, when the report was received. This concern is generated because the reported visibility was below the authorized landing minimum for the flight; if, as has been explained, the report was received before the flight reached the radio facility on final approach, the captain was required to discontinue the instrument approach. After arduous study and careful evaluation of all the evidence, it is the opinion of the Board that the report was re-

CIRCUIT DESIGN ENGINEERS

there are important positions available at

Bendix-Pacific

TELEMETERING... SONAR...
MISSILE GUIDANCE... AIRBORNE RADAR

If you have had two or more years experience in Circuit Design in Telemetering, Sonar, Missile Guidance or Airborne Radar . . . and are interested in moving to a permanent, well paying position in Southern California—

Please write W. C. Walker your qualifications or fill in the coupon and mail today.

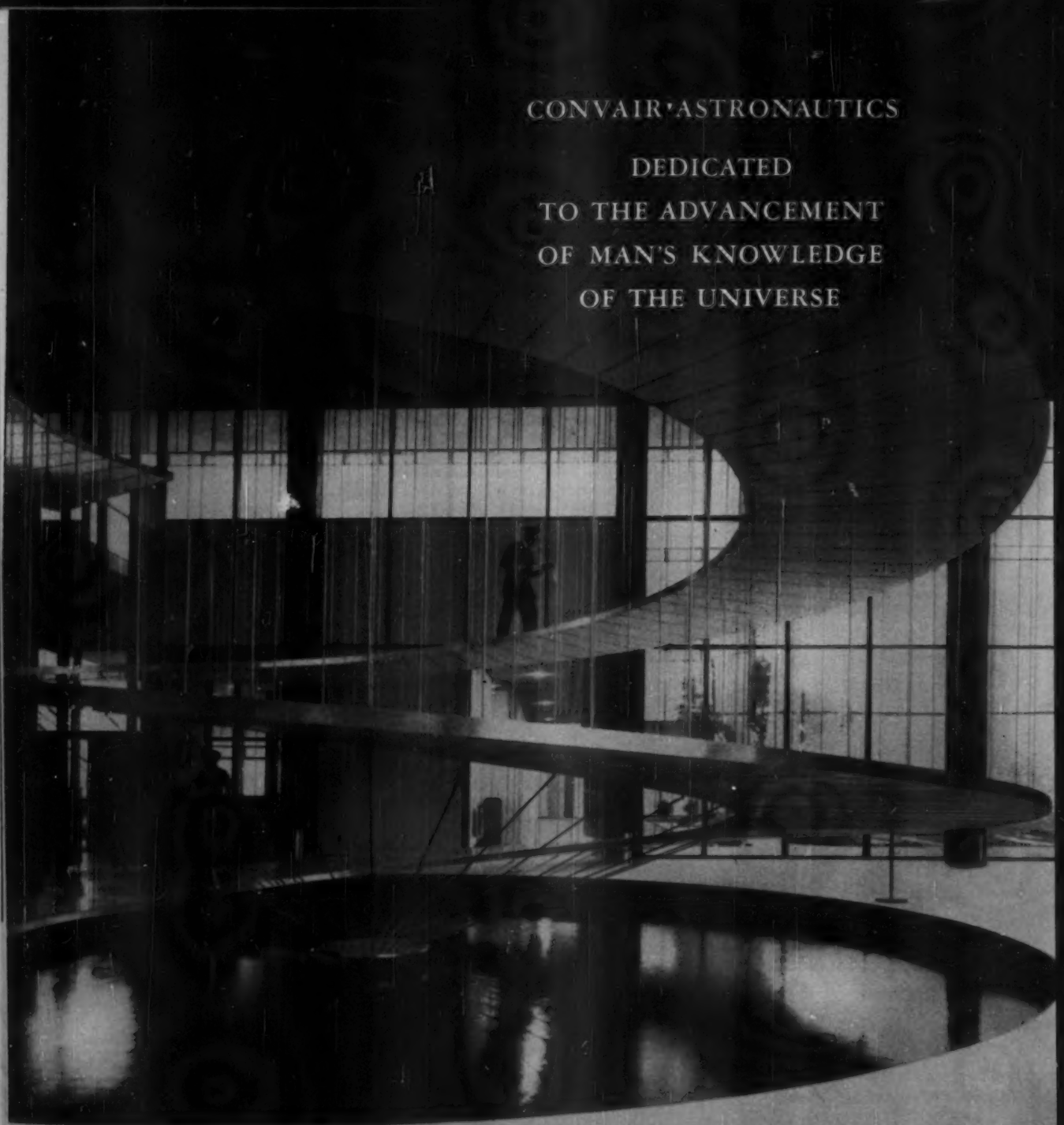
W. C. Walker, Engineering Employment Manager
Bendix-Pacific, Bendix Aviation Corporation
11602 Sherman Way, North Hollywood, Calif.

I am interested in _____ Engineering.
I am a graduate engineer with _____ degree and _____ years experience.

Name _____

Address _____

City _____ Zone _____ State _____

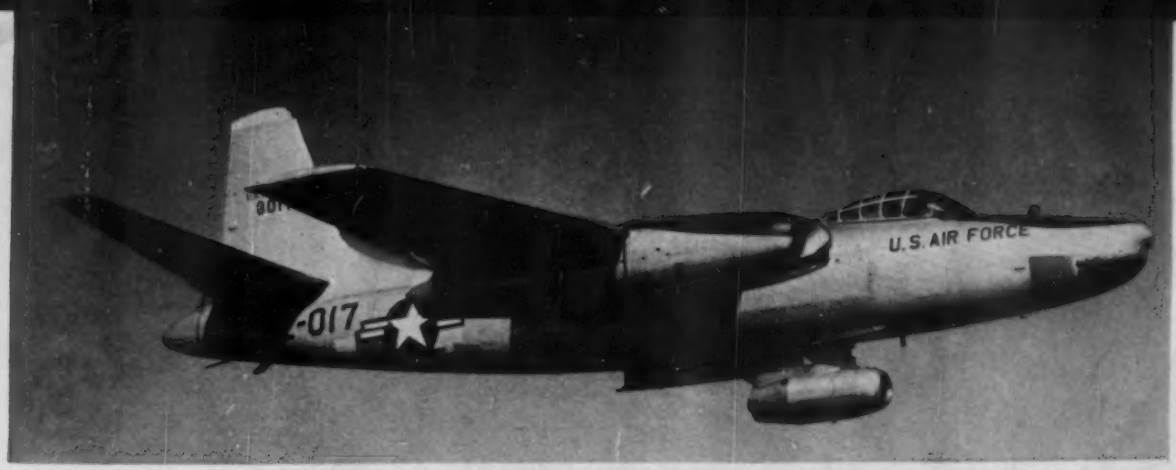


CONVAIR·ASTRONAUTICS

DEDICATED
TO THE ADVANCEMENT
OF MAN'S KNOWLEDGE
OF THE UNIVERSE

Engineers and scientists interested in working on the Atlas and Centaur projects are cordially invited to submit a resume for professional evaluation to Mr. G. N. McMillan, Engineering Personnel Administrator, Department 130-90

CONVAIR | ASTRONAUTICS
Convair Division of
GENERAL DYNAMICS
5502 Kearny Villa Road, San Diego, California



JT12 Installed on Flying Testbed

Pratt & Whitney JT12 turbojet engine, powerplant for the Lockheed Jetstar, McDonnell 119 and North American Sabreliner, has completed flight tests on this North American B-45 jet bomber. The engine, which weighs 430 lb. and produces 3,000 lb. thrust (AW Feb. 2, p. 27), can be equipped with afterburner for military operations, increasing weight to 645 lb. and thrust to 3,900 lb. Engine also will power SD-4 drone manufactured by Republic Aviation Corp. and Fairchild Engine & Airplane Corp.'s SD-5 drone.

ceived and at a time when the approach should have been discontinued. This opinion is based on a determination of the time of the accident and again upon the accuracy of the Northeast radio log. Each of these supports the other and the Otis tape supports both.

At 2328, according to the Otis tape, the flight reported, "We're just past the marker outbound," and at 2330 it reported, "Procedure turn." These reports and ample evidence that the entire approach procedure was flown would place the accident very close to 2334. This time correlates reasonably to the report about 2335 from Flight 2289 that there was a fire at the end of the runway, which the senior agent recorded at 2336 after using approximately one minute to look for the reported fire.

The time of the accident also substantiates the accuracy of the radio log. Its accuracy is further established by the fact that at 2330, according to the Otis tape, Flight 2289 was advised to obtain its clearance through the company and according to the radio log this action was completed and logged at 2331. For this action the various times involved correlate in a precise manner.

From the above evidence the Board accepts as accurate the log entry and the testimony of the company agents regarding the issuance of the below-minimum weather report. Testimony of the senior agent indicates the information was transmitted two times during a 60-90-sec. interval preceding 2333 when the action was completed and logged. Correlated to the timing of the approach procedure Flight 258 would not have passed the VOR inbound and, more specifically, should have been in its procedure turn when the information was first transmitted. Because Flight 258 was released from Otis to company frequency at 2330 and because each transmission of the ¼ mi. visibility was followed by a sound identified as a mike click the Board believes the information was received.

The nature of the local weather conditions may have been a factor in Capt. Burnham's decision to continue the approach. From the available evidence it is apparent that a heavy rolling sea fog extending to at least 300 ft. existed over the airport and into the approach area. It is believed that the fog was very heavy to the "H" facility, rapidly decreasing in density northeastward, until in the area of the VOR the conditions were generally clear. It is possible that as Flight 258 passed over the vicinity of the airport, lights on the airport were clearly visible vertically through the fog. This, together with generally clear conditions in the VOR area, could have led the captain to believe weather conditions were much better at the approach end of runway 24 than at the terminal where the conditions were being measured.

The approach was most likely continued inbound with reference to the ground and by the time the flight reached the "H" facility it was at a low altitude. The low altitude is shown clearly by the light touchdown of the aircraft and the short distance from the "H" facility to the touchdown.

Considering the distance, the computed groundspeed, and that practically all descent had been arrested at touchdown, only an excessive rate of descent would permit the flight to have passed the "H" facility much above 100 ft.

At this altitude and position the Board is convinced that intervening fog between the flight and runway threshold precluded visual reference to the threshold complex. This is clearly substantiated in that the ground tracks of the aircraft were proceeding away from rather than toward runway alignment. It is considered that the relatively short runway may have influenced the descent to low altitude and it is possible that a desire to pick up and follow the line of barrels was a contributing reason.

At low altitude in the area of the "H" facility it is believed that the flight entered the heavy fog bank, described by an eyewitness. It is believed that at this time all ground reference was lost and before transition to instruments could be made and the approach discontinued the remaining altitude was lost and the aircraft contacted the ground.

CONCLUSIONS

In this report the Board has entered criticism of some of the Northeast operational policies and procedures and of the implementation of the operational program. The criticisms are the product of a combined effort—the Board's accident investigation process and a CAA inspection, both of which had the cooperation and assistance of Northeast personnel. The work was accomplished with a common purpose of producing greater aviation safety through improvements wherever possible.

Following the accident the company believed it advisable to discontinue the use of the "Sliding Scale" at Nantucket for a period of re-evaluation. In the absence of an ILS and ladder-type approach lights and in consideration of the authorized deviation, this action appears wise.

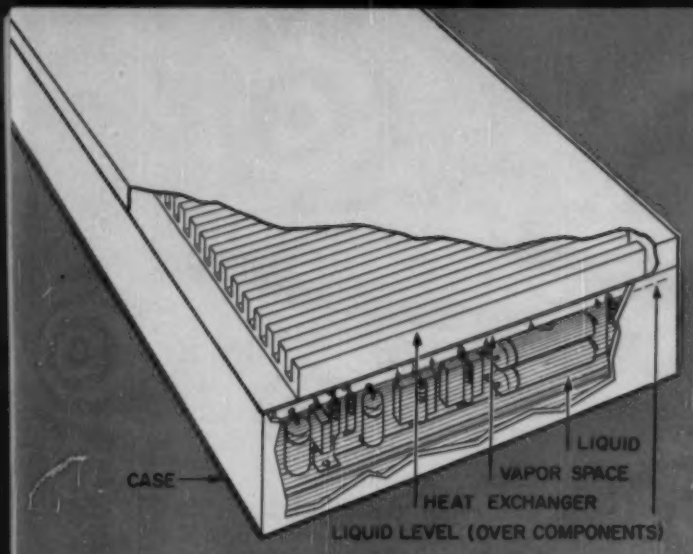
With reference to the ILS and approach lights the Board, through meetings with the CAA and the Weather Bureau, has learned that the installation of a tower, ILS, approach lights and "end of the runway" electronic weather reporting equipment at Nantucket is being actively considered. Such installation would be in accordance with provisions of the CAA planning standards allowing for the installation as an exception to the general requirements.

Many factors in the Nantucket situation qualify it as an exception. Installation of "end of the runway" weather reporting equipment would be in accordance with a Weather Bureau policy to install this equipment as part of the ILS package. Obviously, the above action would be a significant step toward modernization of the airport.

In the meantime, and following the accident, the Weather Bureau took measures to provide Otis RAPCON with all weather observations taken at Nantucket during IFR conditions.

From the considerable testimony regarding the correct interpretation of Item 32 of the Operations Specifications (Limitations on descent below authorized IFR landing minimums) the Board believes that the best operating policy clearly requires adherence to the CAA interpretation. In order to effect its interpretation and because the interpretation is not clearly expressed, the Administrator is presently considering a revision to the language of Item 32.

The company has taken positive steps to eliminate deficiencies in its operational training program which were disclosed in the



In Raytheon's "EV-GRAV" system, liquid refrigerant boils off the surfaces of the individual electronic components, rises as vapor, condenses on the heat exchanger, and drops as liquid to repeat the cycle.

"EV-GRAV" COOLING

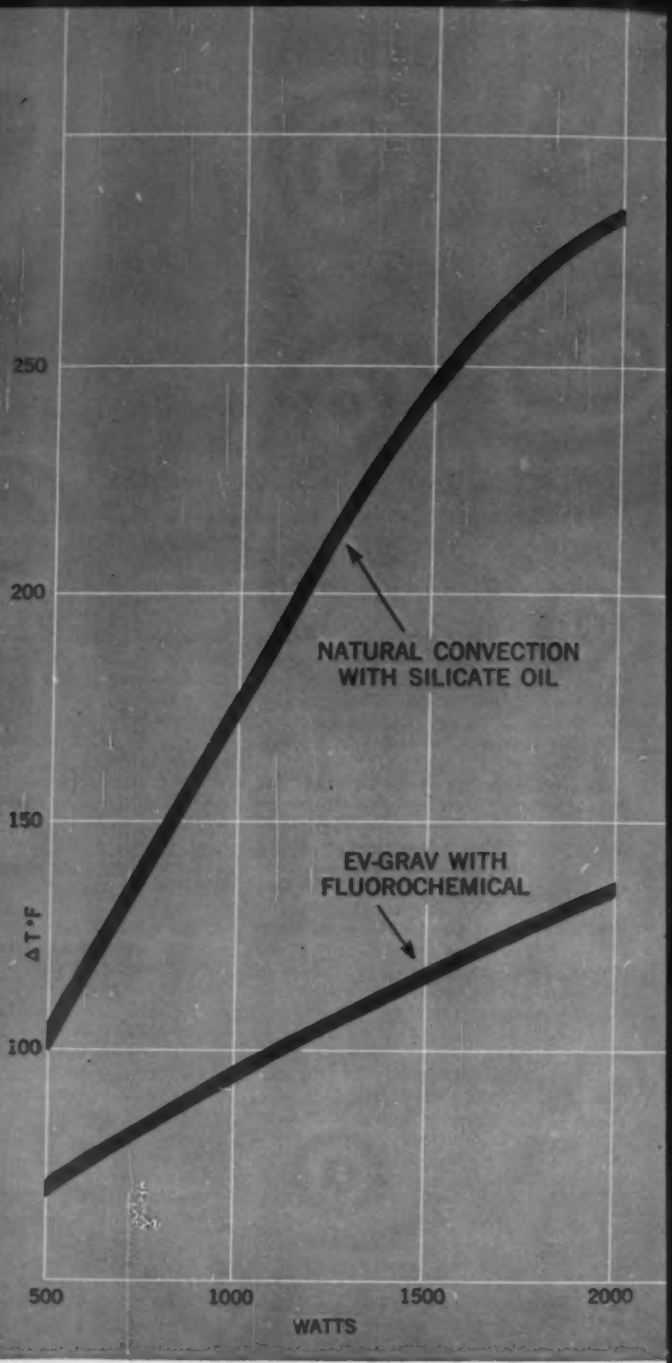
IN THE DESIGN OF HIGH HEAT-DENSITY ELECTRONIC EQUIPMENT

Performance requirements for electronic equipment in supersonic aircraft and missiles place particular emphasis on the need for more efficient heat transfer techniques.

The use of fluorochemical refrigerants in an "evaporative-gravity" cooling system is a novel method of removing heat from electronic components. The refrigerant boils at the surfaces of submerged heat-dissipating components and condenses on the surface of a heat exchanger at the top of the package.

This technique has proved more efficient than free convection in oil dielectrics or forced convection with gas dielectrics. The high dielectric strength of the fluorochemicals permits the achievement of higher density packaging.

Contributions such as this are typical of the Heat Transfer Group in Raytheon's Government Equipment Division . . . assisting design engineers in developing the complex weapons systems of tomorrow.



PROFESSIONAL ASSOCIATION WITH A FUTURE

Qualified engineers and physical scientists with BS or advanced degrees interested in systems, development, design or manufacturing engineering of complex electronic equipments are invited to write Donald H. Sweet, Government Equipment Division, Raytheon Manufacturing Company, Wayland, Massachusetts.

Engineering Laboratories: *Wayland, Maynard, Sudbury, Mass.; Santa Barbara, Calif.*
Manufacturing Facilities: *Waltham, North Dighton, Mass.*

RAYTHEON

Excellence in Electronics

GOVERNMENT EQUIPMENT DIVISION

LAND SEA AEROSPACE

Board's accident investigation and the CAA inspection. The foundation of the action was a re-emphasis of the training function under company supervisors with appropriate delegated authority. Accordingly, company policy now requires that the use of aircraft for training receive the highest priority. It also requires that the various training phases and curriculums not be interrupted by controllable factors. An increased emphasis on current training provides that in addition to the existing program each pilot captain will receive a concentrated ground and flight training period preceding each semiannual instrument check.

Through communications and meetings with company officials and the Administrator and his staff the Board has been kept informed of the aforementioned action as well as other allied measures. It has been reported that a determined effort has been made by the company to satisfy each criticism even though in some specific instances the company believes the criticism was not wholly warranted.

The Board believes that rapid and substantial progress has been made and in many instances the deficiencies have already been corrected.

Most of the areas in which deficiencies were found are the subjects of express provisions of the Civil Air Regulations, some of which require approval of the CAA. Under the responsibility of the Administrator all of the areas require his continued scrutiny through his local staff. Obviously, the operational factors which were identified as deficiencies were generally known and accepted by the local CAA agents prior to the accident.

The Administrator, recognizing this, took action to correct the local situation and also to establish an inspection process whereby closer supervision can be maintained over the effectiveness of CAA offices throughout the country having the same responsibilities.

PROBABLE CAUSE

The Board determines that the probable cause of this accident was the deficient judgment and technique of the pilot during an instrument approach in adverse weather conditions in failing to abandon the approach when a visibility of one-eighth mile was reported, and descending to a dangerously low altitude while still a considerable distance from the runway.

By the Civil Aeronautics Board.

James R. Durfee
Chan Gurney
Harmar D. Denny
G. Joseph Minetti
Louis J. Hector

INVESTIGATION AND HEARING

The Civil Aeronautics Board was notified of this accident shortly after its occurrence and initiated an investigation in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended.

A public hearing was held by the Board in Bennett Hall, Nantucket, Mass., on Oct. 1, 2, and 3, 1958.

AIR CARRIER

Northeast Airlines, Inc., is a Massachusetts corporation with its principal offices in Boston. The carrier is engaged in the trans-

Engineers . . . make your move to a climate of opportunity.

ROHR
WILL BE IN
OR NEAR
YOUR CITY
SOON

Professional opportunities in Southern California for engineers in these fields: Structures, Design, Welding, Bonded Structures, Liaison, Industrial. Men from Rohr will soon be conducting personal interviews in the following cities:

Akron	Chicago	New York
Baltimore	Cincinnati	Philadelphia
Buffalo	Dallas	St. Louis

Detailed resumes from qualified applicants will be held in confidence and given prompt attention in the arrangement of local interviews. Address J. L. Hobel, Industrial Relations Manager, Rohr Aircraft Corporation, Chula Vista, California.

ROHR
AIRCRAFT CORPORATION
CHULA VISTA AND
RIVERSIDE, CALIFORNIA

EXPANDED RESEARCH

to advance new concepts of SPACE FLIGHT

Expanded Research programs to meet the most complex technological requirements of the Space Age are only one of the far-reaching objectives of the new multi-million-dollar Lockheed Research Center, near Los Angeles. Destined to become one of the nation's major research installations, its programs are broad in scope and designed to investigate new frontiers of space flight.

A primary consideration in planning the new Research Center was to provide environment for scientific freedom and ideal research conditions —using the most advanced equipment available. This modern, integrated research facility will touch almost every aspect of aviation and transportation—leading toward exploration into completely new or relatively undeveloped fields of science and industry.

On completion, most of Lockheed's California Division's research facilities will be located in this single area. The Center will provide complete research facilities in all fields related to both atmospheric and space flight—including propulsion, physiology, aerodynamics and space dynamics; advanced electronics in microwave propagation and infrared; acoustics; mechanical and chemical engineering and plasma/magnetohydrodynamics; thermal electricity; optics; data communications; test and servo-mechanisms.

The first phase of the advanced research building program has already begun—with initial construction of a $5,000,000 supersonic wind tunnel and high-altitude environmental test facilities.

Scientists and engineers of high caliber are invited to take advantage of outstanding career opportunities in this new Lockheed Research Center. Openings now exist for thoroughly qualified personnel in: Electronics; aero and thermo dynamics; propulsion; servo-mechanisms; materials and processes; structures and stress; operations research; research in optics, infrared, acoustics, magnetohydrodynamics, instrumentation, mechanics and hydraulics; mathematics and in all phases of design.

Write today to: Mr. E. W. Des Lauriers, Manager Professional Placement Staff, Dept. 11051, 1708 Empire Avenue, Burbank, California.

LOCKHEED

CALIFORNIA DIVISION

BURBANK, CALIFORNIA

portation by air of persons, property, and mail. The company operates under a currently effective certificate of public convenience and necessity issued by the Civil Aeronautics Board and operating certificate issued by the Civil Aeronautics Administration.

FLIGHT PERSONNEL

Capt. John T. Burnham, age 36, was employed by Northeast Airlines on May 24, 1951.

He became captain Sept. 27, 1956. He possessed a currently effective airman certificate with an airline transport rating and DC-3 and Convair type ratings. Capt. Burnham had accumulated 5,608 flying hours with the company, of which 4,028 were in the DC-3, 165 were in the DC-4 and 1,416 were in the Convair. He had flown the route involved numerous times while copilot and captain and had received a satisfactory route check on June 26, 1958. His latest physical examination was satisfactorily accomplished on Mar. 17, 1958.

Records on Capt. Burnham showed the satisfactory completion of all semiannual instrument flight checks except one which was flown on Oct. 14, 1957, and graded unsatisfactory. Following additional Link and flight instruction a recheck on Oct. 16, 1957, was completed satisfactorily. Both the Oct. 14 and 16 flights were accompanied by CAA inspectors and the checking pilot was the assistant chief pilot. Testimony of these persons indicated the discrepancies were not of a serious nature and following training all were corrected.

First Officer David C. Carey, age 23, was employed by Northeast Airlines on June 27, 1957. He held a currently effective airman certificate with commercial and instrument ratings. He was qualified as a first officer on the Convair on July 30, 1957. At the time of the accident First Officer Carey had accumulated 614 flying hours, 296 prior to employment and 318 during employment, of which 132 were in the Convair. First Officer Carey was on leave of absence to complete college from Sept. 15, 1957, until June 15, 1958.

His latest physical examination was satisfactorily completed May 9, 1958.

Stewardess Arlene Dabek, age 23, was employed by the company on Nov. 25, 1957, and received stewardess training until Dec. 10, 1957.

Miss Dabek received her annual physical examination Nov. 25, 1957. She had flown regular schedules from Dec. 14, 1957, until the accident.

THE AIRCRAFT

N 90670, a Convair 240, was manufactured Aug. 22, 1948, and sold to Pan American World Airways. It was purchased by Northeast Airlines April 24, 1954, and of 18,019 hr. on the airframe, 8,773 were accumulated by Northeast. Since the last major aircraft overhaul N 90670 had flown 1,605 hr.

The aircraft was powered by Pratt & Whitney R2800 CB-3 engines, both of which had operated 1,155 hr. since overhaul. The engines were equipped with Hamilton Standard propellers, model 43E606895-12. The left and right propellers, respectively, had operated 1,870 hr. and 869 hr. since overhaul.

THE U.S. TREASURY SALUTES THE AIRCRAFT INDUSTRY

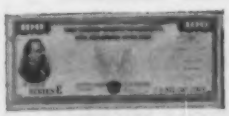
—and its thousands of employees who help strengthen America's Peace Power by buying U.S. Savings Bonds

Men and women who make up the great group who design, fabricate, assemble and test our newest aircraft are also making another substantial contribution to our national security. Many thousands of them are buying U.S. Savings Bonds, regularly, through the Payroll Savings Plan.

Regular purchases of Shares in America help these patriotic and thrift-minded people set up substantial reserves for the education of their children, the buying of new homes and the building of their retirement funds. Through the Payroll Savings Plan the practice of thrift is made easy and automatic.

If your company has not yet put in a Payroll Savings Plan, start now. Your State Savings Bond Director is anxious to help and to show you how easy it is to put the Plan to work. Telephone him now. Or write to Savings Bonds Division, U.S. Treasury Department, Washington, D. C.

L. A. MARTIN, skilled aircraft mechanic, is typical of the thousands of valued employees in this field who are buying U.S. Savings Bonds regularly. Mr. Martin, through his company Payroll Savings Plan, is making a personal contribution to the Peace Power of his country.



THE U. S. GOVERNMENT DOES NOT PAY FOR THIS ADVERTISEMENT. THE TREASURY DEPARTMENT THANKS, FOR THEIR PATRIOTISM, THE ADVERTISING COUNCIL AND THE DONOR ABOVE.

EMPLOYMENT OPPORTUNITIES

NATIONAL COVERAGE

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

Positions Vacant | **Civil Service Opportunities** | **Employment Agencies**
Positions Wanted | **Selling Opportunities Wanted** | **Employment Services**
Part Time Work | **Selling Opportunities Offered** | **Labor Bureaus**

RATES

DISPLAYED

The advertising rate is $45.00 per inch for all advertising appearing on other than a contract basis. Frequency rates quoted on request.

An Advertising Inch is measured ⅞" vertically on a column—3 columns—30 inches to a page.

Subject to Agency Commission.

UNDISPLAYED

$2.70 per line, minimum 3 lines. To figure advance payment count 5 average words as a line.
Position Wanted Ads are ½ of above rate.
Box Numbers—counts as 1 line.
Discount of 10% if full payment is made in advance for 4 consecutive insertions
Not subject to Agency Commission.

Send NEW ADS to Classified Advertising Div. of AVIATION WEEK, P. O. Box 12, N. Y. 36, N. Y.

Specifications Engineers

Lockheed Missiles and Space Division has important positions in specifications engineering at its facilities on the San Francisco Peninsula.

Technical degree or equivalent required, with experience in the preparation, coordination and negotiation of subsystem specifications, military documentation, specifications requirements, and technical writing.

Please send resume to: Research and Development Staff, 962 W. El Camino Real, Dept. E4-17, Sunnyvale, California. U. S. citizenship required.

Lockheed

MISSILES AND SPACE DIVISION

Sunnyvale, California

DISENCHANTED ENGINEERS

If your present employer has failed to utilize your full potential, why not permit us to explore the parameters for your personal qualifications with the many dynamic young companies in aviation, electronics, missiles and rockets. We now have in excess of 4,000 openings in the $8,000 to $40,000 bracket, all of which are fee paid. Why wait? Send resume in duplicate at once to:—

FIDELITY PERSONNEL
1218 Chestnut Street, Philadelphia 7, Pa.

WHERE TO BUY

Cinefonics inc.

Specialists in the production of MOTION PICTURES
for R&D contracts, Table 210 requirements, capabilities, achievements and products

A UNIQUE SERVICE COMBINING ENGINEERING AND FILM TALENT

6401 Oakton Street Morton Grove, Illinois
Phone: Niles 7-6600
TWX: Niles ILL 2270 or 2271

ADDRESS BOX NO. REPLIES TO: Box No. Classified Adv. Div. of this publication. Send to office nearest you.
NEW YORK 36: P. O. BOX 12
CHICAGO 11: 520 N. Michigan Ave.
SAN FRANCISCO 4: 68 Post St.

SELLING OPPORTUNITIES OFFERED

Fluid Control Components—Widely recognized manufacturer of fluid control components for aircraft, missiles and ground support equipment is seeking representation by reputable sales firms in these areas: Boston, Philadelphia, Washington-Baltimore, Detroit, Chicago-Milwaukee, Cleveland-Akron, Huntsville, Alabama. Please forward summary of technical background, references, present accounts and compensation method preferred, to RW-1561, Aviation Week.

Wanted Representatives—Experienced in the sale of gyros & other inertial navigation test equipment & fixtures including related electronics. Sterling Precision Corp., 17 Matinecock Ave., Manor Haven, L. I., N. Y.

POSITIONS WANTED

A&E 23 years, experience, manufacturing, overhaul, maintenance, inspection. Desires responsible position. PW-1489, Aviation Week.

POSITIONS WANTED

Commercial with ATR ratings on Constellation. DC-4, DC-3, B26 & Lodester. Total time 13,726 hrs. with 690 jet. Will travel anywhere, prefer west coast. PW-1477, Aviation Week.

Challenging South American assignment and/ or flying position desired. Airline Transport Pilot, 7900 hours, DC-3, DC-4, DC-6, CV 340, light twins. Age 31, Excellent Spanish. PW-1282, Aviation Week.

SELLING OPPORTUNITY WANTED

Sales engineer, 15 years aircraft and missile experience to represent top flight mechanical, electrical or electronic accessory manufacturer in Pacific Northwest. RA-1557, Aviation Week.

Don't forget the

BOX NUMBER

When answering the classified advertisements in this magazine don't forget to put the box number on your envelope. It's our only means of identifying the advertisement you are answering.

A. B. MURRAY CO. INC.
EST. 1905
AIRCRAFT & MISSILE TUBING FROM STOCK
Elizabeth, N. J. • Bristol, Pa. • McKeesport, Pa.

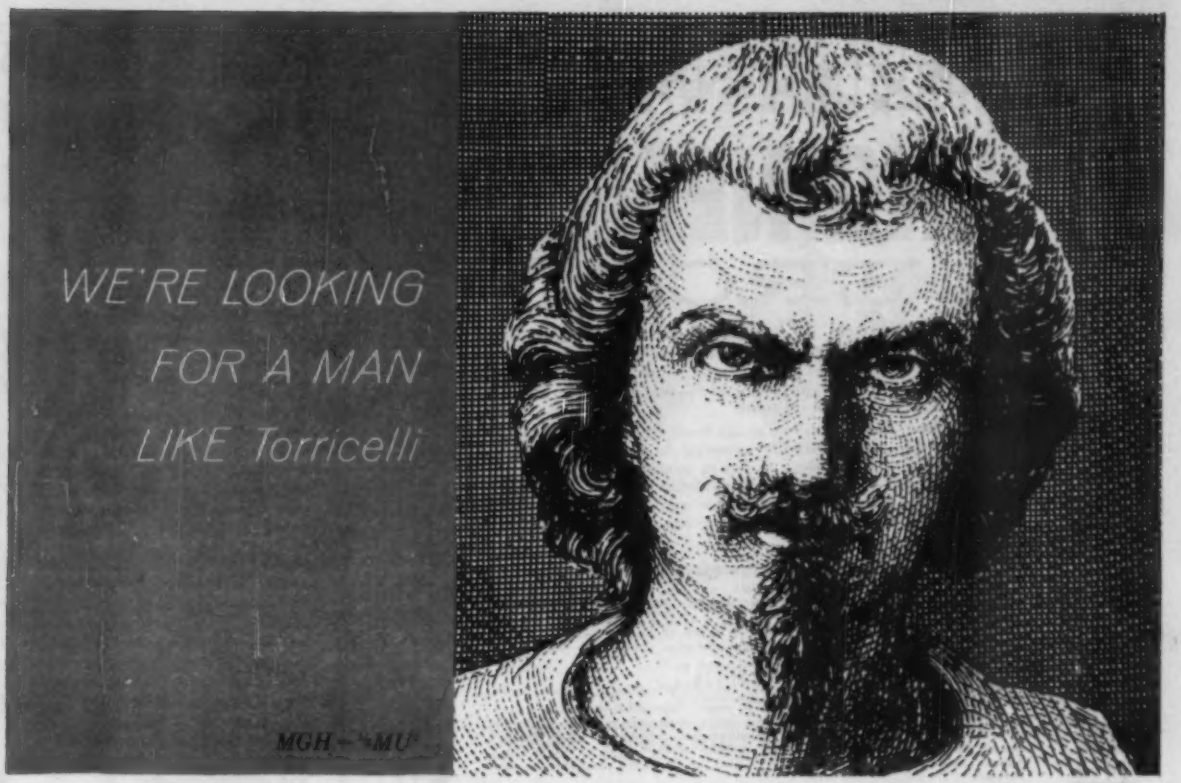
This

WHERE TO BUY *Section*

supplements other advertising in this issue with these additional announcements of products and services essential to the aviation industry.

Classified Advertising Division

AVIATION WEEK



–WITH A MODERN TURN OF MIND

Air has weight—atmosphere has pressure.

This knowledge, centuries old, lies at the base of searching problems facing the exploration of space.

At Goodyear Aircraft, hand-picked men with a modern turn of Torricellian mind are finding rewarding stimulation of their talents in programs involving Crew-Escape Capsules—in the perfection of mass-production nose cones of optimum efficiency.*

New multimillion-dollar research and development facilities—in Akron and in Litchfield Park, Arizona—are manned by this good company of men who would welcome good company like you.

If you have a Torricellian talent and are seeking a challenge that has solid substance and long-range surety—then write direct: Mr. Charles Jones, Director of Technical & Scientific Personnel, Goodyear Aircraft Corporation, Akron 15, Ohio.

*Also programs in rocket propulsion, interplanetary guidance, ground support systems for missiles, nose cones, radar structures, advanced black boxes, radomes and structures engineering.

GOODYEAR AIRCRAFT

ENGINEERS

ERCO

a pioneer and one of the leading producers of electronic flight simulators, is increasing its engineering activity to include volume engineering programs in the fields of analog and digital computer techniques, telemetry, transistor applications and light/optical scanners.

Challenging and diversified assignments in Product Design are offered by this constantly growing organization to the career-minded engineer who wishes to combine stability with the latitude necessary for rapid professional and financial growth. Immediate opening exists for qualified, professional personnel whose areas of experience coincide with the following requirements:

CIRCUIT DESIGN JUNIORS, INTERMEDIATE AND SENIOR, B S E E for transistor circuitry, application, analog and digital computer techniques, DC amplifiers, simulation, telemetry and design of systems and components.
B S in physics, plus experience in one or more of the following: optics, hydraulic instrumentation, human engineering, numerical analysis, computer techniques.

HUMAN FACTORS PhD degree in experimental, physiological or industrial psychology with 3 to 5 years' industrial experience as engineering psychologist or comparable years of experience with military as training and/or proficiency measurement specialist. Will head 3-man team conducting plant-wide human factors efforts, including human engineering of high-fidelity weapon system simulators and trainers.

TECHNICAL WRITERS B S in E E or Physics, or equivalent, plus 2 years' experience in the preparation of operational and maintenance manuals & engineering reports concerning electronic systems & components.

EXCELLENT SALARIES
Commensurate with Education and Experience

MODERN COMPANY BENEFITS
including Educational Assistance Plan

RELOCATION ASSISTANCE

IDEAL LIVING CONDITIONS in suburban Washington, D. C.

Send resume To: Mr. R. J. Reid, Technical Employment Manager

ERCO PLANT

NUCLEAR PRODUCTS—ERCO
DIVISION OF ACF INDUSTRIES INCORPORATED
RIVERDALE, MARYLAND, WARFIELD 7-4444

NEED ENGINEERS?

An employment advertisement in the EMPLOYMENT OPPORTUNITIES SECTION will help you find the engineers you need. It's an inexpensive, time-saving method of contacting competent personnel for every engineering job in the Aviation industry. The all paid circulation of AVIATION WEEK offers you an opportunity to choose the best qualified men available.

For additional information write: Classified Advertising Division

AVIATION WEEK, P.O. Box 12, New York 36, N.Y.

UNUSUAL CAREERS FOR

AERONAUTICAL ENGINEERS

Challenging and rewarding career positions are now open for aeronautical engineers with knowledge and imagination. They will participate in the development of new concepts for advanced operational data processing systems.

Ph.D. with a background in aircraft instrumentation, especially air speed and altitude measurements. Must have a thorough knowledge of servo-mechanisms and electronics, plus a demonstrated creative talent. Flight test experience is desirable.

M.S. with a minor in mathematics and 2 years' experience in the following areas: evaluation of airborne systems, both digital and analog; navigation techniques, including inertial navigation; aerodynamics; data reduction; photogrammetry. Must be capable of analyzing flight test data and handling systems analysis. Will be required to solve problems in spherical trigonometry and photogrammetry.

B.S. with 2 to 4 years' experience in installation of electronic and electromechanical equipment in aircraft. Aircraft company experience is desirable.

B.S. with 2 to 4 years' experience in flight testing of complex electronic equipment, preferably in high performance air vehicles.

PARALLEL OPPORTUNITIES. Both technical and administrative engineering careers offer parallel advancement opportunities and rewards at IBM. You will enjoy unusual professional freedom, comprehensive education programs, the assistance of specialists of diverse disciplines, and IBM's wealth of systems know-how. Working independently or as a member of a small team, your individual contributions are quickly recognized and rewarded. This is a unique opportunity for a career with a company that has an outstanding growth record.

FOR DETAILS, write, outlining your background and interest, to:

Mr. R. E. Rodgers, Dept. 524E1
IBM Corporation
590 Madison Avenue
New York 22, N. Y.

IBM®

Career Openings For ENGINEERS

Expanding R&D programs have created urgent needs for qualified engineers with 3 to 5 years experience as:

STRESS ENGINEERS
DYNAMICS ENGINEERS
WEIGHT CONTROL ENGINEERS
ANALOG COMPUTER ENGINEERS

ELECTRONIC ENGINEERS

B.S. or M.S. in E.E., Physics or Math with experience in one or more of the following fields:

GUIDANCE
INSTRUMENTATION
TELEMETRY
TRANSISTORIZATION PROGRAMS
ANTENNA DESIGN
ECHO, ENHANCEMENT
INFRA RED SYSTEMS
SYSTEMS ANALYSIS
AUTO PILOTS

RELIABILITY ENGINEERS—SPECIALIST

B.S. in A.E., M.E. or E.E. with expr. in state-of-the-arts aircraft reliability techniques. For technical surveillance of over-all projects in this field.

ACOUSTICS ENGINEERS—SPECIALIST

B.S. in A.E., M.E., E.E. or Engineering Physics (M.S. desired) with extensive experience in acoustics. For acoustical analysis, design and installation of rotating machinery including gas turbines to achieve specification noise levels through unusual techniques.

HYDRAULIC ENGINEERS—SPECIALIST

B.S. or M.S. in A.E., M.E. or E.E. with 3 to 5 years aircraft experience. Must be capable of designing complete hydraulic or pneumatic systems, evaluate power requirements, pump capacities, fluids, and temperature ranges.

HUMAN FACTOR ENGINEERS

Requires advanced degree in Engr., Psychology or allied fields with expr. in defining activities to be performed by military weapons systems personnel. To provide human factors criteria for design engineers—work with project personnel for optimum utilization of men and systems during design and development.

THERMO—DYNAMICISTS

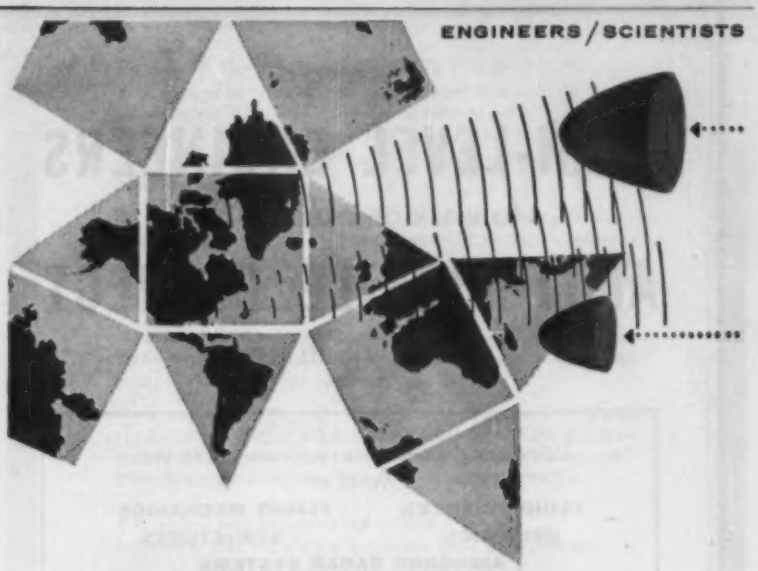
B.S. or M.S. in A.E. or M.E. with 3 to 5 years experience in theoretical process and research. To design and construct apparatus, perform tests, reduce data, and write-up experiments in thermodynamics, heat transfer and fluid flow.

Please mail brief resume to C. K. Jones, Employment Mgr. or Telephone Gene Gregg, MU 34681 (Wichita). Proof of citizenship will be required.

BEECH AIRCRAFT CORPORATION

WICHITA 1, KANSAS

ENGINEERS / SCIENTISTS



GENERAL ELECTRIC'S OBJECTIVE:

CREATE NEW LONG-RANGE RADAR SYSTEMS TO REPLACE BRUTE FORCE DETECTION METHODS

The Missile Detection Systems Section invites engineers with high creative and analytical abilities to join—

SYSTEMS DEVELOPMENT GROUP, which initiates and formulates basic systems concepts related to extremely long-range radar. Optimize the relationship between operational requirements and the most recent developments in the electronic art.

SYSTEMS EQUIPMENT GROUP, which converts generalizations established by Systems men into detailed components that comprise engineering specifications of the systems. Issue purchase specifications; conduct liaison.

At least 4 years' related experience required in one or more of these areas: Radar Systems Engineering; Electronic Countermeasures Systems Engineering; D&D of Antennas, R F Components, UHF & Microwave Receivers, Data Processing Equipment, or Video Display; Computer Applications

Salaries fully competitive, commensurate with experience.
Write in confidence to: Mr. Joseph L. Wool, Div. 64WR
Missile Detection Systems Section

HEAVY MILITARY ELECTRONICS DEPT.

GENERAL ELECTRIC

Court Street, Syracuse, New York

HIGH-LEVEL ENGINEERS

to work on exciting new

ANTI-MISSILE PROJECT

in sunny San Diego

Brilliant ground-floor opportunities in the fields of:

FLUID SCIENCES **FLIGHT MECHANICS**
DYNAMICS **STRUCTURES**
AIRBORNE RADAR SYSTEMS

Solar's new ARPA Project involves a completely new system of anti-missile defense. It is the latest of several highly advanced projects of Solar's Missile and Space Group. The right men joining now will get in on the ground floor and gain key creative positions in their fields of interest. It will be to your advantage to learn complete details immediately.

SOLAR SPECIFICS

Solar is a medium-size company (2500 people in San Diego) with a successful history since 1927. It is big enough to offer the most advanced personnel policies, yet small enough so you don't get lost in the crowd. Salary and performance reviewed semi-annually. Liberal relocation allowances. Solar is making many significant contributions to space-age technology, and the special professional status of engineers is fully appreciated and recognized. A new 60,000 sq. ft. engineering building, necessitated by expanding research and development, will be completed in 1959 on the edge of San Diego Bay.

SEND RESUME

Please send resume of your qualifications at the earliest opportunity to Louis Klein, Dept. E-402, Solar Aircraft Company, 2200 Pacific Highway, San Diego 12, Calif.

SOLAR
AIRCRAFT COMPANY

SAN DIEGO
DES MOINES

LIVE BETTER, TOO! In addition to greater opportunities for personal achievement, Solar also offers you the chance to live better in sunny San Diego. This famous resort area has the finest year-around climate in the U.S. Cultural, educational and recreational facilities are excellent. The new Advanced Sciences Branch of the University of California offers facilities for further study. You and your family will enjoy life more at Solar in San Diego.

FOR ADDITIONAL INFORMATION

About Classified Advertising,

Contact The McGraw-Hill Office Nearest You.

ATLANTA, 3
1301 Rhodes-Haverty Bldg.
JAckson 3-6951
R. POWELL

BOSTON, 16—350 Park Square
HUbbard 2-7160
D. J. CASSIDY

CHICAGO, 11
520 No. Michigan Ave.
MOhawk 4-5800
W. HIGGENS

CLEVELAND, 13
1164 Illuminating Bldg.
SUperior 1-7000
W. B. SULLIVAN—T. H. HUNTER

DALLAS, 2—1712 Commerce St., Vaughan Bldg.
Riverside 7-5117
GORDON JONES—F. E. HOLLAND

DETROIT, 26—856 Penobscot Bldg.
WOodward 2-1793
D. M. WATSON

LOS ANGELES, 17—1125 W. 6th St.
HUntley 2-5450
P. M. BUTTS

NEW YORK, 36—500 Fifth Ave.
OXford 5-5959
H. T. BUCHANAN—R. P. LAWLESS

PHILADELPHIA, 3
Six Penn Center Plaza
LOcust 8-4330
H. W. BOZARTH—T. W. McCLURE

ST. LOUIS, 8—3615 Olive St.
JEfferson 5-4867

SAN FRANCISCO, 4—68 Post St.
DOuglas 2-4600
S. HUBBARD

Openings
at all Engineering
Levels at

SYLVANIA'S MISSILE SYSTEMS LABORATORY

in
Suburban Boston

Studies in the requirements, feasibility optimization, and preliminary design of missile systems; management of complete weapons systems; development of ground-based electronic subsystems and equipment. We are currently staffing experienced and creative engineers for assignments in:

- Preliminary design & analysis of detection communication & navigation systems. Detailed system design of advanced antennas, microwave devices, & signal processing devices. Statistical analysis & simulation of signal processing systems.
- Design & Development of RF circuitry, microwave devices power supplies, RF signal distribution & transmission, & video & pulse circuits.
- Systems analysis & preliminary engineering design studies with major emphasis on real-time data processing, systems simulation, mathematical & statistical analysis, dynamic analysis, & guidance system design.

All replies will be answered within 2 weeks.
Interview and relocation expenses paid by Sylvania.

Please send resume to Graydon A. Thayer
WALTHAM LABORATORIES / SYLVANIA ELECTRONIC SYSTEMS
A Division of
SYLVANIA
SYLVANIA ELECTRIC PRODUCTS INC.
100 First Avenue — Waltham 54, Massachusetts

CLASSIFIED SEARCHLIGHT SECTION ADVERTISING

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

DISPLAYED RATE:
The advertising rate is $31.00 per inch for all advertising appearing on other than on contract basis. Contract rates on request.
AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.
EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

UNDISPLAYED RATE:
$2.70 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.
PROPOSALS, $2.70 a line an insertion.
BOX NUMBERS count as one line additional in undisplayed ads.

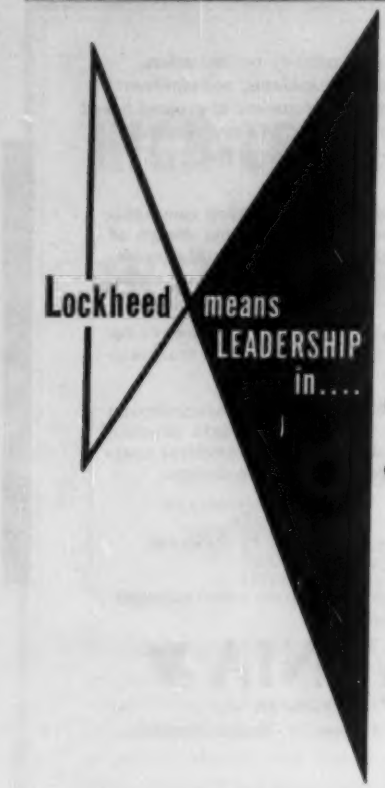
Send NEW Ads or Inquiries to Classified Adv. Div. of Aviation Week, P. O. Box 12, N. Y. 36, N. Y.

Immediate Delivery
We stock, overhaul, and install
PRATT & WHITNEY R1830 -75, -92, -94
WRIGHT R1820 -202, -5, -72
R985 R1340 R2000
and our most popular DC3 engine
R1830 - SUPER - 92
ENGINE WORKS INC.
Lambert Field Inc. St. Louis, Mo.

FOR SALE
DOUGLAS DC-4Bs.
Former United Airliners
DOUGLAS C-47B, completely zero time. Cargo or passenger interior.
Priced for quick sale.
Call or write Madden & Playford Aircraft Inc.
P. O. Box 186 Miami 48, Fla.
Tel. TUxedo 7-9821

WANTED PBY
Previously licensed. To be used in CAR-43 operations.
Johnson Air Interests, Inc.
Horlick Racine Airport
Racine, Wisconsin
Melrose 7-1102

FOR SALE
C-46F AIRCRAFT
Passenger and Cargo
With or Without
T-Category Kit Installed
Immediate Delivery
THE FLYING TIGER LINE INC.
Burbank, Calif.
Call or Cable
FRED BENNINGER
Executive Vice President
Tel: Stanley 7-3411 Cable: Flytiger



- *nuclear products*
- *aircraft design*
- *operations research*
- *special products*

At the GEORGIA Division of LOCKHEED positions of significant scope and responsibility are open to qualified Engineers and Scientists in the fields of:

PRELIMINARY DESIGN
FLIGHT TEST
ELECTRONICS
TECHNICAL WRITING
STRUCTURES—WEIGHT

THEORETICAL PHYSICS
NUCLEAR ENGINEERING
MATHEMATICS

OPERATIONS RESEARCH

SPECIAL PRODUCT DESIGN

for immediate consideration write in confidence to
W. P. Key
Engineering and Technical Placement
Lockheed Aircraft Corporation
834 W. Peachtree St., N.W.
Atlanta 8, Georgia

LOCKHEED AIRCRAFT CORP.
GEORGIA DIVISION
marietta, georgia

SEARCHLIGHT SECTION

(Continued from page 131)

FOR SALE

High Altitude Aircraft

FOUR LOCKHEED P-38's

Altitude Capabilities to 40,000 Feet

Aircraft have modified nose section suited for technician and instruments. Ideal for economic high altitude testing. Operating costs are diminutive compared to that of jet aircraft. Reasonably priced.

Write or Wire:

HYCON MFG. COMPANY
1030 South Arroyo Parkway
Pasadena, California

EXECUTIVE DC-3 FOR LEASE AVAILABLE MAY 15, 1959

- Super plush executive 13 passenger interior.
- Complete dual Flight Group instrumentation. Vacuum & electric.
- Dual 360 Ch. VHF Communications System.
- Dual Omni and maximum instrumentation & RMI.
- Equipped for all weather flying.
- Low time airframe & engines. New license & 100 hour inspection.

Principals only.

T. I. A. CORP.
Box 48-233, Miami Int'l Airport
Tuxedo 7-5527

NEW, UNUSED POWER SUPPLIES

28—VOLT DYNAMOTORS
43—output 500 vdc, 6.0 amps
77—output 235 vdc, 4.0 amps
74—output 255 vdc, 435 Ma.
28 Dynamotor-Commutator Gating Unit (hi-speed, elec.-mech. switch)
40—Variable Reactance Oscillator (various freqs. 1.3—14.5 Kc)

FS-1486, Aviation Week
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

AN FITTINGS & HARDWARE

Stainless, Aluminum, Brass, Steel

All sizes—immediate delivery from world's largest shelf stock. Buy direct from manufacturer. Lower prices—quicker service. Send for free wall charts showing complete line of AN & MS fittings and hardware. We also machine parts to your own special print, and stock AN & MS forgings.

COLLINS ENGINEERING CORPORATION
9050 Washington Blvd. Culver City, California

HILLER HELICOPTER

Modernized UH12B with complete agricultural spray equipment. *Very low terms*

EAST COAST AVIATION CORPORATION
Lexington 73, Massachusetts

Wanted for Export

Active exporters looking for Export Distributorship. Would invest or purchase interest in Aviation line salable to our Overseas clients.

BO-1428, Aviation Week
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

If there is anything you want that other readers can supply
OR . . . something you don't want— that other readers can use—
Advertise it in the
SEARCHLIGHT SECTION

ADVERTISERS IN THIS ISSUE

AVIATION WEEK, MAY 4, 1959

AEROJET—GENERAL CORPORATION 192
Agency—D'Arcy Adv. Company
AIRBORNE ACCESSORIES CORP. 148
Agency—Gray & Rogers, Adv.
AIRCRAFT TURBINE SERVICE, INC. 77
Agency—Industrial Marketing Assoc.
AIR FRANCE 48
Agency—Batten, Barton, Durstine & Osborn, Inc.
AIRWORK CORPORATION 63
Agency—Gene Wyble Advertising
ALPHA CORP. 35
Agency—Don L. Baxter, Inc.
ALUMINUM CO. OF AMERICA 18
Agency—Fuller & Smith & Ross, Inc.
AMERICAN AIR FILTER CO. 162
Agency—Zimmer, McClaskey Advertising
AMERICAN LATEX PRODUCTS CORP. 195
Agency—Raymond E. Wallace Adv., Inc.
ARMSTRONG WHITWORTH AIRCRAFT 62
Agency—Dolan Ducker Whitcomb & Stewart, Ltd.
AUTONETICS DIV. NORTH AMEICAN AVIATION, INC. 166
Agency—Batten, Barton, Durstine & Osborn, Inc.
AVCO MANUFACTURING CORP., CROSLEY DIVISION 182
Agency—Robert Acomb, Inc.
AVIATION WEEK 196-197
Agency—Gaynor & Ducas, Inc.

BENDIX HAMILTON DIV., BENDIX AVIATION CORP. 146
Agency—MacManus, John & Adams, Inc.
BOEING AIRPLANE COMPANY 54
Agency—Calkins & Holden, Inc.
BONANZA AIRLINES 160
Agency—Gaynor & Ducas, Inc.
BRISTOL SIDDELEY ENGINES, LTD. 58-59
Agency—Young & Rubicam, Ltd.
BURNDY CORP. 15
Agency—Ted Gravenson, Inc.
BUSINESS WEEK 194
Agency—Royal & De Guzman, Inc.

CALIFORNIA TECHNICAL INDUSTRIES 90
CAMLOC FASTENER CORP. 86
Agency—Lewis Advertising
COLORADO RESEARCH 60
COLLINS RADIO CO. 17
Agency—W. D. Lyon Co.
COLE ELECTRIC COMPANY 190
Agency—Tazzart & Young, Inc.
CONSOLIDATED ELECTRODYNAMICS CORPORATION 191
Agency—Hixson & Jorgensen, Inc.
CONTINENTAL AVIATION & ENGINEERING CORP. 165
Agency—The Hopkins Agency
CONVAIR—DIVISION OF GENERAL DYNAMICS CORPORATION .....2nd Cover
Agency—Lennen & Newell, Inc.
CONVAIR ASTRONAUTICS ENGINEERING 200
Agency—Barnes Chase Co.

DELTA AIR LINES 129
Agency—Burke, Dowling, Adams, Inc.
DONNER SCIENTIFIC CO. 10
Agency—Bonfield Assoc., Inc.

ECLIPSE—PIONEER DIVISION—BENDIX AVIATION CORPORATION 170-171
Agency—MacManus, John & Adams, Inc.
EDGEWATER STEEL COMPANY 76
Agency—Downing Industrial Advertising, Inc.
ELASTIC STOP NUT CORPORATION OF AMERICA .....4th Cover
Agency—G. M. Basford Company
ESSO EXPORT CORPORATION, AVIATION PRODUCTS 16
Agency—McCann Erickson, Corp.

FLYING TIGER LINE, INC. 76
Agency—Hixson & Jorgensen, Inc.

GARLOCK PACKING CO., THE 149
Agency—Hutchins Adv Co., Inc.
GENERAL ELECTRIC COMPANY 36, 144-145
Agency—G. M. Basford Company
GENERAL ELECTRIC COMPANY X-RAY DEPT. 136
Agency—Klau-Van Pietersom-Dunlap, Inc.
GENERAL PRECISION LABORATORY, INC. 13
Agency—Gaynor & Ducas, Inc.
GILFILLAN BROS., INC. 44
Agency—Erwin Wasey, Ruthrauff & Ryan, Inc.
GOODRICH COMPANY, THE B. F. 28
Agency—Batten, Barton, Durstine & Osborn, Inc.

HADLEY, INC., B. H. 155
Agency—Jackson & Morse Adv.
HAMILTON STANDARD DIVISION—UNITED AIRCRAFT CORPORATION 181
Agency—Lennen & Newell, Inc.
HAYDU INDUSTRIES, INC. 147
Agency—Nationwide Assoc., Inc.
HAYNES STELLITE CO., DIV. OF UNION CARBIDE CORP. 24
Agency—J. M. Mathes, Inc.
HILLER AIRCRAFT CORP. 188
Agency—Boland Assoc.
HI SHEAR RIVET TOOL COMPANY 152
HOLLEY CARBURETOR COMPANY 8-9
Agency—Clark & Bobertz, Inc.
HUGHES AIRCRAFT COMPANY 134, 188
Agency—Foote, Cone & Belding

JOHNSON 175

KING FIFTH WHEEL CO. 153
Agency—Bub Adv., Inc.
KENNEDY & CO., D. S. 4
Agency—Larcom Randall Adv., Inc.
KELSEY HAYES COMPANY 129
Agency—Zimmer, Keller & Calvert, Inc.
KOPPERS CO., INC. 66
Agency—Van Sant Dugdale & Co., Inc.
KOCH & SONS, H. 12
Agency—North Baker

LAVELLE AIRCRAFT CORPORATION 5
Agency—The Roland G. E. Ullman Org.
LIBRASCOPE, INC. 14
Agency—Compton Advertising, Inc.
LITTON INDUSTRIES, INC. 132
Agency—Calkins & Holden, Inc.
LOCKHEED AIRCRAFT CORPORATION 178-179
Agency—Foote, Cone, Belding Adv.
LOCKHEED AIRCRAFT CORPORATION 97, 204
Agency—Hal Stebbins Adv.

M B MFG. CO. 129
Agency—Marsteller, Rickard, Gebhardt & Reed, Inc.
MALLORY SHARON TITANIUM CORPORATION ... 84
Agency—The Griswold-Eshleman Company
MAGNAVOX GOV. & INDUS. DIV. 184
Agency—Rothhardt & Haas Adv., Inc.
MARTIN COMPANY, THE 156-180
Agency—Vansant, Dugdale & Company, Inc.
MAXIM DIVISION, EMHART MFG. CO. 131
Agency—The Charles Brunelle Co.
MINNEAPOLIS HONEYWELL REGULATOR COMPANY 74-75
Agency—Foote, Cone & Belding
MOTOR GENERATOR CORP. 76
Agency—Ralph Dalton & Assoc.

NAPIER & SON, LTD., D. 64
Agency—Erwin Wasey, Ruthrauff & Ryan, Inc.
NEW DEPARTURE DIVISION—GENERAL MOTORS CORPORATION 72
Agency—D. P. Brother & Company
NORTH AMERICAN AVIATION, INC. ...151, 185, 190
Agency—Batten, Barton, Durstine & Osborn, Inc.
NORTHROP AIRCRAFT, INC. 80
Agency—Erwin Wasey, Ruthrauff & Ryan, Inc.
NORTHEAST AIRLINES, INC. 198
Agency—J. Walter Thompson Co.
NORTH CENTRAL AIRLINES 75
Agency—Klau-Van Pietersom-Dunlap, Inc.

PACIFIC AIRMOTIVE CORPORATION 130
Agency—Gaynor & Ducas, Inc.
PACIFIC DIVISION—BENDIX AVIATION CORPORATION 199
Agency—The Shaw Company Adv.
PACKARD—BELL TECHNICAL PRODUCTS 3
Agency—Robinson, Jensen, Fenwick & Haynes, Inc.
PAN AMERICAN WORLD AIRWAYS, INC. 50-51
Agency—J. Walter Thompson Company
PENNSALT CHEMICALS CORP. 161
Agency—The Altkin-Kynett Co.
PORTER CO. INC., H. K. THERMOID DIV. 139
Agency—Erwin Wasey, Ruthrauff & Ryan, Inc.
PIPER AIRCRAFT CORPORATION 186
Agency—Davis Parsons & Strohmeier, Inc.

RADIO CORPORATION OF AMERICA 138, 154
Agency—Al Paul Lefton Company, Inc.
RAYTHEON MANUFACTURING COMPANY 202
Agency—Donahue & Coe, Inc.
REDA PUMP CO. 141
Agency—Watts, Payne-Adv., Inc.
RESISTOFLEX CORPORATION .....3rd Cover
Agency—Marsteller, Rickard, Gebhardt & Reed, Inc.
REVERE CORPORATION OF AMERICA 137
Agency—W. L. Towne Adv.
ROHR AIRCRAFT CORPORATION 203
Agency—Barnes Chase Company
ROLLS ROYCE LTD. 125
Agency—The Wesley Associates, Inc.
RYAN AERONAUTICAL COMPANY 11
Agency—Batten, Barton, Durstine & Osborn, Inc.

SCOTT AVIATION CORP. 174
Agency—Melvin F. Hall Adv., Inc.
SINCLAIR REFINING COMPANY 176
Agency—Morey, Humm & Warwick, Inc.
SOCONY MOBIL OIL COMPANY, INC. 172
Agency—Compton Adv., Inc.
SPRAGUE ELECTRIC CO. 142
Agency—The Harry P. Bridge Co.
SPACE TECHNOLOGY LABORATORIES 7
Agency—Gaynor & Ducas, Inc.
SPENCER THERMOSTAT DIV. 61
Agency—Sutherland Abbott Adv.
STANDARD PRESSED STEEL COMPANY 148
Agency—Gray & Rogers Adv.
STAVID ENGINEERING, INC. 128
Agency—Gaynor & Ducas, Inc.

TECO, INC. 196
Agency—Jayecraft Co.
TEMCO 143
Agency—Rodgers & Smith
TEXAS CO., THE 53
Agency—G. M. Basford Co.
TEXAS INSTRUMENTS INCORPORATED 164
Agency—Don L. Baxter, Inc.
THIOKOL CHEMICAL CORPORATION 150
Agency—Brown & Butcher, Inc.
THOMPSON-RAMO-WOOLDRIDGE, INC. 189
Agency—Meldrum & Fewsmith, Inc.
TORRINGTON COMPANY, THE 82
Agency—Hazard Adv. Company
TRANS-SONIC, INC. 6
Agency—Louis K. Frank Co.
TRANS WORLD AIRLINES, INC. 48
Agency—Foote, Cone & Belding

UNITED AIRCRAFT PRODUCTS, INC., MISSILES & SPACE SYSTEMS DIV. 138
Agency—Chambers, Wiswell, Shattuck, Clifford & McMillan
UNITED AIRLINES 58
Agency—N. W. Ayer & Sons, Inc.

VICKERS, INC., DIVISION OF SPERRY RAND CORPORATION 168-169
Agency—Witte & Burden Adv.
VICKERS ARMSTRONG, LTD. 42-43
Agency—McCann Erickson, Inc.

WEST COAST AIRLINES 177
Agency—Miller, Mackay, Hneck & Hartung, Inc.
WESTINGHOUSE ELECTRIC CORPORATION 90-91
Agency—Fuller & Smith & Ross, Inc.
WYANDOTTE CHEMICALS CORPORATION 63
Agency—Brooke, Smith, French & Dorrance, Inc.

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 206-212
EQUIPMENT
(Used or Surplus New)
For Sale 211-212
WANTED
Miscellaneous 211

ADVERTISERS INDEX

WHERE TO BUY
Cinefonics, Inc. 206
A. B. Murray 206
Booch Aircraft Corporation 209
Collins Engineering Company 21
East Coast Aviation Corp. 212
Engine Works 211
Eros Plant 208
Fidelity Personnel Service 206
Flying Tiger Line Inc., The 2
General Electric (HMED) 209
Goodyear Aircraft Corp., The 207
Hycon Manufacturing Company 212
International Business Machines Corp. 208
Johnson Air Interests, Inc. 21
Lockheed Aircraft Corporation 212
Lockheed Missiles & Space Div. 206
Maddox & Playford Aircraft, Inc. 211
Remmert-Werner, Inc. 211
Solar Aircraft Company 210
Sylvania (Waltham) 211
T. I. A. Corp. 212

LETTERS

Pilot Experience

I ask you quite frankly, what are you trying to prove? The tenor of your publication over the past several months has been a constant derision of the ability, integrity, and intelligence of the airline pilots of this nation.

You do a great disservice to the aviation industry by printing half truths, innuendos, and uninformed opinions which confuse and spread doubt into the minds of the traveling public. If you place no significance on 20 years cockpit experience, 20,000 hr. of day-in-day-out flying, a military record rewarded with this nation's highest honors, or hundreds of hours of research flying, just who would you and certain of your readers like to see flying airline aircraft?

Airplanes are machines, they are flown by men. Let's not write either one off with malicious slander.

GORDON C. BLANCHARD
Captain, Eastern Air Lines
Marblehead, Mass.

Jeopardized Defense

Some of the criticism directed at you in AVIATION WEEK's Letters section regarding your stand on more adequate defense has left me disturbed. I have waited some time since most of those letters were published in order that I might "cool down." I'm cooled, but I find I still feel like offering a rebuttal.

On the premise that all of the writers had patriotic motives, I found the thing that disturbed me most was seemingly complete disregard for all the lessons of history. One nation does not attack another unless he believes he is stronger and hence can win. Also, in the power politics game that the world is engaged in at the present time, you don't bargain from a position of weakness and hope to come out anything better than second best. For these two reasons alone we must be the strongest, militarily speaking, because as long as the "enemy" has a dictatorial form of government, history as well as the pronouncements of Marx and Lenin tell us that we can expect war when they believe they are stronger.

I'm certainly in favor of a balanced budget, but not at the expense of an adequate defense. I can't help but wonder if your same critics express as loud a criticism to their congressmen or local newspapers regarding the appalling waste that goes on every year in stockpiling corn, cotton and wheat. Perhaps they also disregard the myriad welfare programs that the taxpayers bankroll every year. And, you certainly can't disregard the huge attendant administrative costs of these schemes.

To paraphrase one of the noisiest of your critics, the President with all of his military background certainly should know whether we have an adequate defense, more so even than a magazine editor. I would be the first to agree; however, the facts as shown by exhaustive studies tell us otherwise. I'm referring to the Gaither Report and a study completed by the Rockefeller brothers. Both of these reports have advocated a program of military spending, the magnitude of which would leave pale by comparison, the funds requested by the heads of the services to bring their branches up to adaquate strength. As to whether we can afford this type of defense, one can turn to the conclusion of a study made by the Committee for Economic Development. They reported that this country could spend considerably more for defense than is presently being done without jeopardizing our economic future.

If the leaders of this country don't stop preoccupying themselves with the economics of an adequate defense, the statement that I believe Lenin made that "when we Communists are at last ready to hang the capitalists, they will be trying to out-bid each other for the right to supply the hemp," will come true.

JACK WARD
Santa Monica, Calif.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Weather Flying

The danger of midair collision has been built up into a horrible bogeyman, constructed of a minimum of fact and a maximum of propaganda.

In order to redress the balance somewhat, I made a summary of CAB reports for the last 11 years, 1948-1958 inclusive, giving the causes of all accidents on our scheduled domestic airlines that resulted in fatalities to passengers.

There were a total of 46 such accidents, two of which were caused by passengers exploding bombs aboard.

Of the remaining 44, six were midair collisions—which sounds very bad until we examine it more closely.

Three of the six were caused by illegal actions on the part of a pilot. (Buzzing a small plane; crossing low over a crowded airport without clearance; flying in the overcast without clearance.) Obviously you do not prevent law breaking by making more laws.

Two of the remaining collisions were caused by military training flights along airways. This practice has now been discontinued.

This leaves exactly one midair collision in 11 years, and this was not the result of high closure speeds or overcrowded airways or any of the rest of it, since both aircraft were piston-propelled and the accident took place in one of the most deserted regions of the country.

What the summary shows clearly is that the real killer along the airways is flying in bad weather, and if the authorities would do more about that (such as providing radar and ILS to our smaller airports) they would do more good to aviation than in pursuing their present impossible dream of total control.

MARION HART
New York, N. Y.

Radiation Weapons

My letter on the subject of a radiation weapon (specifically, a transmutation beam), published in AVIATION WEEK Nov. 25, 1957, p. 126, aroused considerable comment, and most of that comment could have been summarized as "Ha, ha! What nonsense!"

Are those commentators still laughing, after reading in AVIATION WEEK (Mar. 2, p. 18) that the Advanced Research Projects Agency will soon award contracts for the study of such "nonsensical" devices as radiation weapons?

Will they still be laughing when the Russians put a man in orbit on or about May Day, an achievement which will be the first step toward the construction of a manned satellite, the optimum site for a radiation weapon?

Caution and scepticism are indispensable when considering the possibilities opened up by the advance and technology, but God preserve America from those who can only laugh at such possibilities.

The concluding sentence of my 1957 letter is still true: "This, then, is the threat of the satellite . . . the enemy's ability to bombard the United States with radiation. . . ."

ALFRED MACHADO, JR.
New Bedford, Mass.

Satellite Optics

I recently enjoyed your three articles on the series of Satellite Reconnaissance Optics in the Jan. 19, Jan. 26 and Feb. 2 issues. I have referred to these articles several times since receiving the issues.

The issues of this foremost publication in the field of aviation and space form a valuable section of my reference library. As I refer to these articles frequently, I would like to receive a reprint of them so that I will not have to cut them out of my reference issues.

W. E. HORN
Westinghouse Electric Corp.
Friendship International Airport
Baltimore, Md.

Keep 'Em Flying

Three cheers for Mr. Charles W. Key, Seattle, Wash., (AW Feb. 2, p. 102).

Count me in on the private flying list, too. Granted we all need rockets and missiles for our defense and our pocketbooks, but we can't joyride one on a Sunday afternoon, no matter how much freedom we have. Let's keep the little guy flying, and let's keep him in AVIATION WEEK. Anyone else for the band wagon?

JULIAN DOSKOW
Quality Control
Republic Aviation Corp., N. Y.

NON AGING – ready for instant service at any time – that's medium and high pressure Fluoroflex®-T hose fabricated from Teflon® resin. Working life is unlimited for practical purposes.

Permanent reliability is *assured* by a manufacturer with *complete control of hose production*, and fitting and assembly fabrication. It is *confirmed* by use on virtually all liquid fuel and many solid fuel missiles . . . *proved* by years of in-flight service on military and commercial aircraft.

Handles the most corrosive fluids, including the exotic fuels, at extreme temperatures. Fluoroflex-T hose assemblies are ideal for use in launching and fueling systems as well as in fuel and hydraulic control systems – up to 4000 psi.

End properties of products made from Teflon powder can change significantly with even minor alterations in processing. Your best guarantee of absolute reliability is the manufacturer's experience. Specify Fluoroflex-T for the hose that's backed by unequalled experience in fluorocarbon hose. Write Dept. 249, RESISTOFLEX CORPORATION, Roseland, N. J.

®Fluoroflex is a Resistoflex trademark, reg., U.S. pat. off.
®Teflon is DuPont's trademark for TFE fluorocarbon resins.

Originators of high temperature fluorocarbon hose assemblies. **Resistoflex**

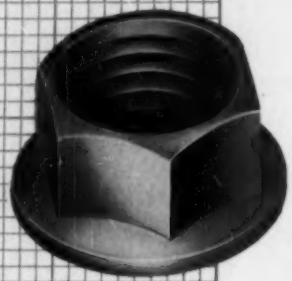
ROSELAND, NEW JERSEY • WESTERN PLANT: BURBANK, CALIF. • SOUTHWESTERN PLANT: DALLAS TEX.

UNIVERSITY MICROFILM I
STEVENS RICE GS
413 N 1ST ST
ANN ARBOR MICH

ESNA gives the design decision to the engineer

If your major consideration is . . .

. . . WEIGHT REDUCTION

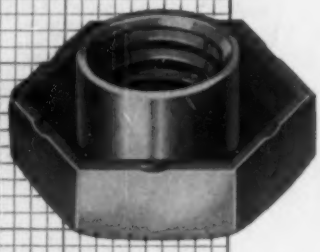


Type LH3324 (160,000 psi)

THIS NEW DESIGN is ESNA's recommendation for applications where space and weight reduction are primary needs. Meets MIL-N-25027; reduced wrenching dimensions permit more efficient centerline bolt design; wrench heights carefully engineered to assure satisfactory assembly line performance. Materials: carbon steel, AMS6304 alloy steel and A286 stainless steel.

wt in lbs per 1000	Screw Size # 4	# 6	# 8	# 10	¼"	5/16"	3/8"	tensile rating
LH3324	.2	.6	1.3	1.4	2.9	5.4	7.3	160,000 psi
NAS679	.9	1.7	2.4	2.6	4.6	6.4	8.6	140,000 psi
AN365	1.4	2.6	4.2	5.0	9.0	12.0	18.0	140,000 psi

. . . USE OF NAS STANDARD HARDWARE

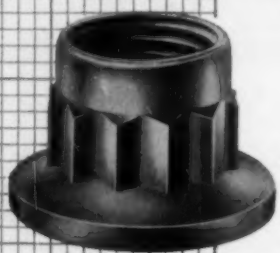


Type LHTE-TM (NAS 679 140,000 psi)

This complete line of low-height, lightweight NAS 679 hex nuts has been designed and produced to ESNA's exacting quality standards. Qualified to MIL-N-25027. External-internal wrenching surfaces for easy installation in limited access areas. Sizes 4-40 through 7/16-20. Alloy steel for temperatures to 550°F; A286 stainless steel for temperatures to 900°F and nonmagnetic applications.

ESNA offers a complete line of ALL NAS types of self-locking nuts, including standard and miniature anchors, floaters and gang channels.

. . . ULTRA-HIGH TENSILE AND FATIGUE PERFORMANCE



Type LH3393 (220,000 psi)

Specify types LH 3393 and LHEB 220 for the utmost in high tensile and fatigue-life performance. Highest strength-to-weight of any available double hex design. Cold-formed from alloy steels; sizes ¼-28 thru 1". For use at temperatures to 550°F.

Other lightweight 12 point nut series are available in several tensile capacities and materials for service at temperatures to 1300°F.

Fit the fastener to the application from the only complete line of self-locking fasteners

ELASTIC STOP NUT CORPORATION OF AMERICA

Dept. 536-525, Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, New Jersey

Please send me the following free fastening information:

☐ Complete dimensional and performance data of the new type 3324 nut.

☐ Visual Index: A complete pictorial representation of all standard Elastic Stop nuts.

Name_____ Title_____

Firm_____

Street_____

City_____ Zone____ State_____